Women's health after having a baby
exploring the impact of severe maternal morbidity on psychological and physical health at 6-8 weeks postpartum

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Women's health after having a baby: exploring the impact of severe maternal morbidity on psychological and physical health at 6-8 weeks postpartum

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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August 2012

Abstract

Background
The incidence of severe maternal morbidity (SMM) is increasing in high-income countries as a consequence of increased obstetric intervention and increasingly complex medical needs of women who become pregnant. The most commonly reported SMM in the UK includes postpartum haemorrhage and hypertensive disorders. Access to emergency obstetric care means that for the majority of UK women, SMM is unlikely to result in loss of life. However, little was known about the impact on postnatal morbidity

Aim
To assess the impact of SMM (defined as major obstetric haemorrhage, severe hypertensive disorders, critical care unit admission) on maternal health, focusing particularly on post-traumatic stress disorder (PTSD) symptoms at 6-8 weeks postpartum.

Method
A prospective cohort study was undertaken of women who gave birth over six months in 2010 in one inner city maternity unit in England. Data on health outcomes were collected on 1824 women using self-administered questionnaires at 6 – 8 weeks postpartum (response rate=53%). The questionnaire included several validated measures to assess aspects of postnatal health and well-being. Multivariable logistic regression analysis examined the relationship between SMM and PTSD adjusting for potential confounders and differences in other postnatal outcomes between women with and without SMM.

Results
There was a higher risk of PTSD symptoms following SMM (intrusion: OR=2.22, 95%CI=1.26-3.93, p=0.006; avoidance: OR=3.33, 95%CI=2.06-5.40, p<0.001; both intrusion and avoidance: OR=3.22, 95%CI=1.62-6.43, p=0.001). Women's sense of control during labour and birth and neonatal outcomes contributed to the risk of PTSD symptoms. There were no statistically significant differences in other mental outcomes, however women with SMM had poorer physical health than women without SMM. Associations between SMM, breastfeeding practice and health service use were inconsistent across indicators of SMM.

Conclusion
Findings have important implications for women's health, and the content and organisation of maternity services. Women and clinicians should be aware that SMM can trigger symptoms of PTSD, with further work required to promote care to prevent these symptoms.

Acknowledgement

First, I would like to thank my supervisors, Professor Debra Bick and Professor Jane Sandall, for their excellent support for my academic work. Without their generous time, invaluable guidance, commitment and encouragement, I would have never completed my doctoral work.

I would like to thank Dr. Derek Cooper for his statistical advice during the course of my study which enabled me to enrich my statistical knowledge. I would also like to thank Dr. Paul Seed, Dr. Peter Miligan and Dr. Naohiro Yonemoto for their statistical comments at the early stage of the study.

I am very grateful to Dr. Kirstie Coxon who, as a friend and a colleague, has always provided me with intellectual and personal support.

Sincere thanks to Mrs. Lynne Packanowski, Mrs. Annette Briley and Ms. Mary Sheridan and Mr. Waqas Shah for their help in data collection. I would like to thank the midwives and midwifery managers in the study site.

I am deeply grateful to all the women who participated in the study for sharing their experiences during birth and postnatal period. Their commitment to this study will hopefully improve maternity care in the future.

Special thanks also to Christie Goodall, Bennie Agbagwara, Veronica Zuccolo and Roxanna Crosby-Nwaobi for their friendship and support.

Finally, I would like to thank my family, Minetoshi Furuta, Tokihisa, Naomi, Sena, and Tsubasa Hamano and Katsushi Hara for their endless support and love.

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Chapter 1

Introduction

Improvements in public health and advances in medical management, including safer anaesthesia and better identification and management of risk factors, have reduced the maternal mortality rate in the UK over the last 50 years. The overall maternal mortality rate was 11.39 per 100,000 maternities during 2006-2008, according to the most recent report of the Confidential Enquiries into Maternal Deaths (CMACE 2011), a decrease from 14 per 100,000 maternities for 2003-05 (Lewis et al. 2007). Since maternal mortality has declined, 'near miss' events or severe maternal morbidity are increasingly referred to as more useful indicators of safety and quality of maternity care (Penney et al. 2007).

In Scotland, data on fourteen major maternal morbidity outcomes such as major obstetric haemorrhage and eclampsia are audited each month as part of the Scottish Confidential Audit of Severe Maternal Morbidity. Along with CMACE reports (CMACE 2011; Lewis et al. 2007), findings from the Scottish audit suggest two important ideas. First, some clinical conditions (such as obstetric haemorrhage) appear more amenable to alteration by prompt and appropriate medical intervention than others. Second, the causes of maternal deaths are not necessarily the causes of maternal morbidity. Therefore, preventing death does not necessarily mean reducing the incidence of morbidity or subsequent effects on a woman's life (Penney et al. 2007). In addition, Campbell and colleagues pointed out, "the incidence of chronic conditions following complicated childbirth could even increase, as women with chronic sequelae survive" (1997, p.12).

Several studies and on-going audits of maternal near miss morbidity have found that major obstetric haemorrhage, particularly postpartum haemorrhage (PPH), continues to be the most common life-threatening obstetric complication in many developed countries, with some indication that the incidence of PPH is increasing (Joseph et al. 2010; Joseph et al. 2007; Penney et al. 2007). Major obstetric haemorrhage and hypertensive disorder (also a common life-threatening complication) are considered to be well-managed medical emergencies in the UK, with the majority of women's lives saved. However, failure to consider the longer-term consequences of these conditions has resulted in a limited understanding of the sequelae experienced by women in the postnatal period and beyond.

Observational studies that have focused on commonly experienced morbidity (i.e., backache, incontinence, perineal pain, depression) have been published (Glazener et al. 1995; Hovens et al. 2000; Walsh and Downe 2005) but study of the sequelae of an experience of severe maternal morbidity is relatively new, resulting in an evidence gap to inform a continuum of timely and effective maternity care. Waterstone et al. (2003) drew attention to the negative consequences of severe maternal morbidity, such as women's sexual health and wellbeing six months after delivery, suggesting further research was needed on how to predict and manage poor outcomes of severe maternal morbidity.

Although for many women giving birth is a major and positive life event (Boyce and Condon, 2000), sometimes memories and perceptions of birth may lead to a poor psychological outcome, with evidence that assisted or difficult births are particularly associated with the onset of psychological problems (Astbury et al. 1994). Studies have also shown that the level of intervention during labour and birth affects the risk of experiencing fear and anxiety (Creedy 1999). The combination of experiencing a

life-threatening complication along with the medical interventions required to sustain the life of these women may culminate in both psychological and physical health problems (Engelhard et al., 2002). This might 'trigger' post-traumatic stress disorder (PTSD) in the postnatal period (Ayers and Pickering 2001; Creedy et al. 2000; Ryding et al. 1997), which is estimated to affect approximately 3% to 6% of women at around six weeks following childbirth (Olde et al. 2006). Few studies to date have examined maternal psychological or physical morbidity following severe maternal morbidity.

Much maternal morbidity, including mental health problems, remains relatively 'hidden' despite the longer-term consequences for public health (Bastos et al. 2008; Ayers et al. 2007). Studies have identified the longer-term negative impact of maternal mental health problems on aspects of child development (Halligan et al. 2007; Sharp et al. 1995), and found that long-term morbidity, if not identified or appropriately managed, could increase the use of secondary healthcare services by women and their families (MacArthur et al. 2003; Waterstone et al. 2003). It is important that the psychological and physical consequences of severe maternal morbidity are examined.

The aim of this research is therefore to assess the impact of women's experiences of severe maternal morbidity on their postnatal health focusing particularly on PTSD symptoms in the early postnatal period, 6-8 weeks postpartum. Three specific objectives were addressed:

1) Obtain data on the prevalence of postnatal PTSD symptoms and other physical and psychological outcomes among women who gave birth in one inner city maternity unit in England.

2) Assess whether there are differences in frequency and severity of postnatal PTSD symptoms and other physical and psychological outcomes between women with and without SMM.
3) Examine the relationship between SMM and PTSD symptoms, taking into account other factors that might influence the relationship between them.

To achieve these objectives, a prospective cohort study was undertaken of women who gave birth in a large inner city maternity unit in England. The study results could contribute to the UK maternal policy and practice by providing evidence on health outcomes of women who experienced severe maternal morbidity.

Chapter 2

Severe Maternal Morbidity

As a basis for identifying current knowledge regarding the issues related to maternal morbidity as well as appropriate methods used to measure them, this chapter reviews the concept, definition and criteria of severe maternal morbidity. The chapter also reviews the incidence and recent trends of the most frequently occurring severe maternal morbidities and contributing factors.

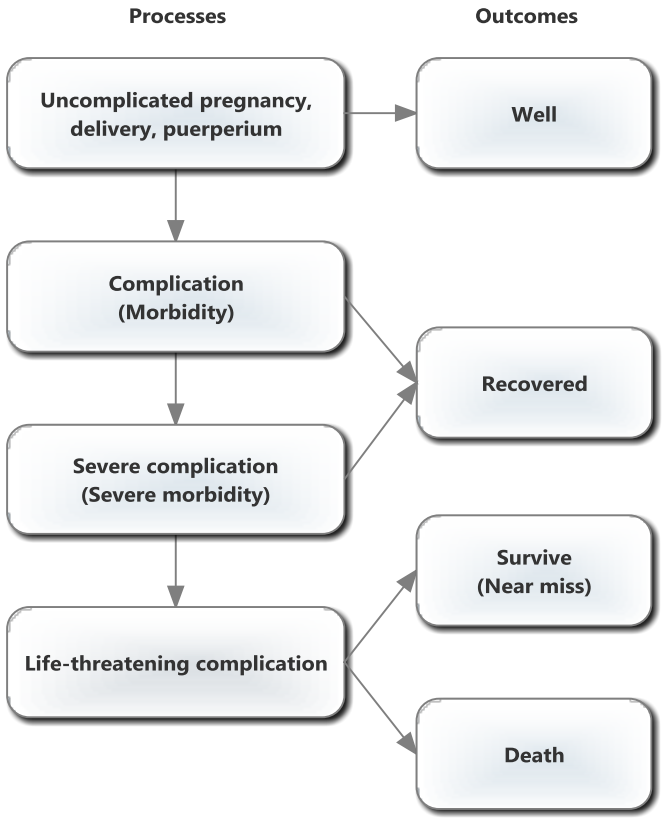
2.1 Concept, definition and criteria for severe maternal morbidity

2.1.1 Concept

The concept of severe maternal morbidity, also known as a maternal 'near-miss', has emerged as a useful outcome by which to measure the safety and quality of obstetric care (Mantel et al. 1998; Stones et al. 1991). Mantel et al. (1998, p.986) described maternal near-miss as "very ill, pregnant, or recently delivered women who would have died had it not been [for] luck and good quality care". This concept is increasingly becoming important, particularly in settings where the maternal mortality ratio is low or where the geographical area is small (Say et al. 2004). Since a larger number of women will experience potentially life-threatening maternal complications than maternal death, studying severe maternal morbidity, or near-miss events may provide greater insight into particular risk factors for obstetric complications, which in turn could support the development of evidence-based interventions to prevent future cases (Knight 2008b; Mantel et al. 1998; Say et al. 2009; Sekharan 2011; Waterstone et al. 2001).

The terms ‘near-miss’ and ‘severe morbidity’ are often used interchangeably (Knight 2008b). Ronsmans and Filippi (2004) distinguish between these, regarding the presence of a maternal illness as an event on a continuum between the two health extremes of ‘normal’ and ‘death’ (Figure 2.1). In their model, ‘severe morbidity’ refers to a serious illness that can develop into a ‘life-threatening complication’ if the complication is not managed and puts a woman’s life on the border of survival or death. Here ‘severe morbidity’ is seen as a *process* towards either survival or death (Ronsmans and Filippi 2004). Conversely, ‘near-miss’ is one of the binary *outcomes* of life-threatening complications, as an alternative to ‘death’ and is only used when a woman survives the complication, implying a positive outcome when considering the event retrospectively (Ronsmans and Filippi 2004).

Figure 2. 1 Pregnancy continuum between extremes of normal and death



Source: Ronsmans & Filippi, (2004, p.105)

Vais & Bewley (2006) also argued that there was a difference between 'near-miss' and 'severe maternal morbidity', pointing out the inappropriateness of using the term 'near-miss'. They stated that "the term 'near-miss' is no longer used, as [this] concept was originally derived from the aviation industry and referred more to risk management than the effect on the women. In contrast, [severe maternal morbidity] refers to the morbidity a woman actually suffers" (Vais and Bewley 2006, p340). Similarly, in the International Classification for Patient Safety (ICPS: World Health Organization 2009), a near-miss is related more to a medical error than to a patient's status, and as such is viewed as an incident which did not affect the patient (e.g., a unit of blood intended for the wrong patient, but the error was detected before transfusion commenced).

When considering women's actual experiences and the subsequent impact of experiencing an obstetric complication on their psychiatric functions, it seems more appropriate to use the term 'severe maternal morbidity' which is the term used throughout this thesis.

2.1.2 Identification of severe maternal morbidity

There is no universally accepted definition of severe maternal morbidity because the severity of the condition is often determined by multiple factors, such as a woman's general health status, availability and accessibility of medical treatment, and human and technical resources in the healthcare system in a specific setting (Ronsmans and Filippi 2004; Vais and Bewley 2006). There is also no general agreement as to what severe maternal morbidity actually comprises (Ronsmans 2001a; b). Criteria used to identify cases of severe maternal morbidity vary from study to study, but

Say et al. (2004) suggested that these criteria can be categorised into three approaches:

i) Clinical criteria related to a specific disease entity, such as eclampsia or haemorrhage;
ii) Management-based or intervention-based criteria, such as admission to an intensive care unit (ICU) or procedure, such as emergency hysterectomy; and
iii) Organ system dysfunction criteria, such as shock or respiratory distress.

Each of the three approaches has advantages and disadvantages for identifying severe maternal morbidity (Say et al. 2004; Say et al. 2009). For example, the use of a disease-specific approach has certain advantages because it is routinely measurable (Waterstone et al. 2001) and cases can therefore be identified retrospectively. With a specific disease-based approach, complication rates for a particular disease can also be calculated, and the quality of care for that disease assessed (Say et al. 2004; Say et al. 2009). However, some acute illnesses such as pulmonary embolus (an important cause of maternal death in the UK), are difficult to diagnose accurately unless they are fatal; therefore, cases may be omitted from studies (Waterstone et al. 2001). Another issue relates to disagreement on the case definition of each type of severe maternal morbidity and cases are often identified with low threshold criteria, which may not necessarily be life-threatening (Say et al. 2009). In addition, disease-based criteria are highly dependent on clinical records. Diligent healthcare units may report disproportionally higher rates of severe maternal morbidity since these cases are more likely to be picked up as a result of accurate documentation, while poor quality healthcare units tend to underestimate the incidence by not recording or even recognising all cases

of severe morbidity (Vais and Bewley 2006). On the other hand, use of an organ system dysfunction based approach enables the identification of all severe morbidities, and does not systematically exclude any particular condition. For this reason, Say et al. (2004) suggested that this approach is least open to bias and the most epidemiologically sound. However, it is the most labour intensive for case assessment and cause analysis, and the aetiology of the organ system failure may not have any prognostic value (Knaus 1993; Say et al. 2004).

A management-based approach is considered advantageous in identifying cases in a simple manner, since it relies on less controversial indicators (van Roosmalen and Zwart 2009a). van Roosmalen and Zwart (2009a) assumed that most women with severe organ system dysfunction were likely to be admitted to an ICU. A combination of a management-based approach with an organ system dysfunction based approach may identify more or less the same patient group. However, transfer of a patient to an ICU often depends on the availability of beds or unit policies, which could result in an underestimation of the true incidence of severe morbidity (Say et al. 2004; Vais and Bewley 2006).

In summary, different approaches are used to identify severe maternal morbidity. Say et al. (2009) suggested that the criteria for identification must be locally usable and globally relevant, allowing comparison across settings. Table 2.1 shows the criteria used in three prospective population-based studies on severe maternal morbidity conducted in the UK (Lennox 2011; Penney et al. 2007; Waterstone et al. 2001) and in the Netherlands (Zwart et al. 2008b). The Scottish Confidential Audit of Severe Maternal Morbidity (Lennox 2011; Penney et al. 2007), which commenced in 2003, covers all consultant-led maternity units in Scotland. Using a combination of three approaches, data on fourteen major maternal morbidity outcomes are

audited monthly, including major obstetric haemorrhage, eclampsia, renal or liver dysfunction, and septicaemic shock (Lennox 2011; Penney et al. 2007). Waterstone et al. (2001) collated data from all maternity units in South East England and used the disease-specific approach. The nationwide Dutch study by Zwart et al. (2008b) was based on disease-based and management-based approaches. However, all three studies presented data on obstetric haemorrhage and hypertensive disorders, indicating that these are key criteria to measure severe maternal morbidity.

Table 2. 1 Criteria used to measure severe maternal morbidity

	England: South East Thames (Waterstone et al. 2001)	Scotland (Lennox 2011; Penney et al. 2007)	Netherlands (Zwart et al. 2008b)
Disease-based			
Severe pre-eclampsia	x		
Eclampsia	x	x	x
HELLP syndrome	x		
Severe haemorrhage	x	x	x
Severe sepsis (septicaemic shock)	x	x	
Uterine rupture	x		x
Massive pulmonary embolism		x	x
Organ system dysfunction-based			
Renal or liver dysfunction		x	
Cardiac arrest		x	
Pulmonary oedema		x	
Acute respiratory dysfunction		x	
Coma		x	
Cerebro-vascular event		x	
Status epilepticus		x	
Anaphylactic shock		x	
Septicaemic shock		x	
Management-based			
Intensive care/coronary care		x	x
Anaesthetic problem		x	

2.2 Incidence, trends and factors associated with severe maternal morbidity

Table 2.2 (p.30) shows the incidence of severe maternal morbidity in the UK and other high-income countries: the Netherlands, the US and Canada. The three studies conducted outside the UK were included as these were nationwide, population based studies, which examined both incidence and associated factors of severe maternal morbidity.

The incidence of severe maternal morbidity varied between studies, ranging from 3.8 per 1000 deliveries in Scotland (Brace et al. 2004) to 14.1 per 1000 deliveries in Canada (Liu et al. 2010). Incidence also varied between hospitals within single studies. For example, Zwart et al. (2008b) showed a wide range of incidence of severe maternal morbidity between different types of hospital (0 to 39 per 1000 deliveries) with the highest mean incidence in university hospitals (26.7 per 1000 deliveries). These differences may be explained, in part, by differences in study cohorts, the definition of severe maternal morbidity used, ascertainment, clinical management, study period, and the method of data collection between the study settings (Joseph et al. 2010; Smith and Dixon 2007). Studies in Scotland, England and the Netherlands collected data prospectively using a pre-specified definition of severe maternal morbidity, while in the US and Canadian studies, data were collected retrospectively using diagnosis codes associated with severe maternal morbidity such as the Canadian version of the International Statistical Classification of Diseases and Related Health Problems (ICD-10-CA). However there are some limitations on the use of this coding system to estimate the incidence of severe maternal morbidity since the data are essentially administrative and used primarily

to record diagnoses for billing[1] and sometimes miscoded (Callaghan et al. 2008). There are also potential differences in codes used and in coding practices between study settings. The coding system did not permit identification of the severity of medical conditions such as severe pre-eclampsia and severe obstetric haemorrhage (e.g., severe haemorrhages with estimated blood loss≥1500 ml were not separated from less severe haemorrhages with an estimated blood loss of more than 500ml but less than 1500ml) (Joseph et al. 2010; Joseph et al. 2007; Liu et al. 2010; Pallasmaa et al. 2008).

Although the criteria used to measure severe maternal morbidity and case definition of each type of severe maternal morbidity varied between studies, obstetric haemorrhage has consistently been reported as the most frequent cause of severe maternal morbidity. In the latest Scottish audit (Lennox 2011; Lennox and Marr 2011), major obstetric haemorrhage affected 78% of women with severe morbidity. It accounted for 56% of all cases of severe maternal morbidity in one health region in England (Waterstone et al. 2001) and 63% in the Netherlands at population level (Zwart et al. 2008b). Moreover, the overall increase in severe morbidity observed in Scotland was largely due to an increase in the rate of postpartum haemorrhage defined as estimated blood loss over 2500mls (Lennox 2011; Lennox and Marr 2011; Penney et al. 2007). A similar trend was observed in retrospective register-based studies in the US which have also highlighted increasing rates of severe maternal morbidity due to obstetric haemorrhage requiring blood transfusion (Callaghan et al. 2010; Callaghan et al. 2008).

Table 2.2 summarises, where possible, the risk factors of severe maternal morbidity identified in each study. It is important to note that the denominator used to

[1] Information was obtained from personal communication with the author, Dr. William M. Callaghan

calculate incidence varied between studies; these included ‘per 1000 births’, ‘per 1000 maternities’, ‘per 1000 deliveries’ and ‘per 1000 live births’. However, Lennox and Marr (2010) noted in the Scottish audit of severe maternal morbidity that “in practice, calculated rates are very similar regardless of whether the denominator used is maternities, live births or total births” (p.5) because of the low incidence of severe maternal morbidity. As the table shows, the risk and associated factors of severe maternal morbidity were more or less similar between studies in high-income countries. In many studies, severe morbidity was more common at the extremes of reproductive age and for ethnic minorities, especially for black compared to white women. Caesarean birth (emergency and elective were not distinguished in many studies) also carried a significantly higher risk of life-threatening maternal complications than vaginal birth; these outcomes are likely to reflect context and models of care.

Table 2. 2 Incidence of severe maternal morbidity

Study population	Study	Study year	Sample size	Incidence* - *per 1000 births [a] /maternities [b]/ deliveries [c]/live births [e]* (95% CI)	Risk or associated factors - RR (95% CI)
England - South East Thames	Waterstone et al. (2001)	1997-1998	48,865	12.0 (11.2-13.2)[c]	Maternal age ≥ 35 years 1.46 (1.11 to 1.92) Other race vs. White (OR: 1.93; 1.24-2.99) Social exclusion: yes vs. no (OR: 2.64; 1.69-4.11) Diabetes: yes vs. no (OR: 1.76; 0.43-7.20) Taking iron at booking (OR: 5.53; 2.28-13.41) Taking antiepileptics at booking: yes vs. no (OR: 5.31; 1.40-20.13) Previous PET: yes vs. no (OR: 1.52; 1.02-2.27) Previous PPH : yes vs. no (OR: 2.41; 1.53-3.77) Antenatal admission to hospital: yes vs. no (OR: 1.75: 1.37-2.23) Multiple pregnancy vs. singleton (OR: 2.21; 1.24-3.96) Induction of labour on medical grounds: yes vs. no (OR2.45; 1.68-3.57) Emergency caesarean section vs. -- (OR: 3.39-5.49) Manual removal of placenta: yes vs. no (OR: 9.6; 5.67-16.28)
Scotland	Brace & Penney (2004)	2001-2002	51,165	3.8 (3.3-4.4)[c]	--
	Penney (2008) Penney & Adamson (2007)	2003-2005	159,223	5.3 (5.0-5.7)[b]	--
	Lennox (2011a, 2011b)	2006-2008	174, 430	5.9 (5.5-6.3)[e]	--
	Lennox (2011b)	2009	54,910	6.7 (6.0-7.3)[e]	--
Netherlands	Zwart et al. (2008b)	2004-2006	358,874	7.1 (--)[c]	Maternal age≥35 vs. -- (RR: 1.2; 1.1-1.3) BMI≥25 kg/m^2 vs. -- (RR: 1.3; 1.1-1.4) Non-Western immigrant vs. Western women (RR: 1.3; 1.2-1.5) Initial antenatal care by obstetrician vs. -- (RR: 3.3; 3.1-3.6) Nullparity vs. -- (RR: 1.2; 1.1-1.3) Multiple pregnancy vs. singleton (RR: 4.9; 4.3-5.7) Artificial reproduction techniques: yes vs. no (RR: 2.5; 2.1–3.0) Previous caesarean section: yes vs. no (RR: 3.7; 3.4–4.1) Current caesarean section vs. -- (RR: 4.6; 4.2–5.0) Ventouse/forceps vs. -- (RR: 1.6; 1.4–1.7) Breech presentation vs. -- (RR: 1.7; 1.4–1.9) Pre-term birth vs. term birth (RR: 6.6; 6.0–7.2)

Study population	Study	Study year	Sample size	Incidence* - *per 1000 births [a] /maternities [b]/ deliveries [c]/live births [e]* **(95% CI)**	Risk or associated factors - RR (95% CI)
US	Callaghan et al. (2008)	1991-1994 1995-1998 1999-2003	423,480 (over the study period between 1991 & 2003)	4.5 (--)[c] 4.7 (--)[c] 5.9 (--)[c]	Maternal age<20 vs. 20-29 (RR: 1.40, 95%CI: 1.09-1.70) Maternal age≥40 vs. 20-29 (RR: 1.67, 95%CI: 1.08-2.25) Black vs. White (RR: 1.95, 95%CI: 1.60-2.29) Caesarean birth vs. vaginal birth (RR: 6.06, 95%CI: 5.02-7.09) Region: South vs. Midwest (RR: 1.41, 95%CI: 1.10-1.71) Region: Northwest vs. Midwest (RR: 1.47, 95%CI: 1.13-1.81)
Canada	(Joseph et al. 2010) (Liu et al. 2010)	2003 2007	248,496 284,925	14.1 (--)[c] 13.9 (--)[c]	Age<15 vs. 20-25 (RR: 2.2, 95%CI: 1.33-3.63) Age 15-19 vs. 20-25 (RR: 1.22, 95%CI: 1.14-1.31) Age 35-39 vs. 20-25 (RR: 1.27, 95%CI: 1.20-1.33) Age≥40 vs. 20-25 (RR: 1.76, 95%CI: 1.63-1.89) Parity 0 vs. 1 (RR: 1.43, 95%CI: 1.38-1.48) Parity≥3 vs. 1 (RR≥1.37, 95%CI:--) Elderly primigravida: yes vs. no (RR: 1.72, 95%CI: 1.55-1.90) Previous caesarean birth: yes vs. no (RR: 1.49, 95%CI: 1.43-1.55) Current caesarean birth: yes vs. no (RR: 3.72, 95%CI: 3.62-3.83) Induction: yes vs. no (RR: 1.16, 95%CI: 1.12-1.20) Twin vs. singleton (RR: 3.33, 95%CI: 3.10-3.58) ≥Triplet vs. singleton (RR: 6.13, 95%CI: 4.58-8.30)

Note: OR: odds ratio
RR: relative risk in Callaghan et al. (2008) and Zwart et al. (2008); rate ratio in Joseph et al. (2010)
-- Data were not available
* For the comparison of incidence, 'per 1000' was used for denominator

2.3 Incidence and risk of mortality

Along with the UK Confidential Enquiries into Maternal Deaths (CMACE 2011; Lewis et al. 2007), findings of studies of severe maternal morbidity suggest some clinical insults are more amenable to alteration by prompt and appropriate medical intervention than others. For example, obstetric haemorrhage is the most common form of severe maternal morbidity in the UK, followed by hypertensive disorders (eg. severe pre-eclampsia/eclampsia), but these are relatively well-managed medical emergencies with a low fatality rate. Sepsis has lower incidence rates, despite being the most common direct cause of maternal death in the UK (CMACE 2011; Lewis et al. 2007). A delay in recognising sepsis, which in the UK is often a community acquired infection (most women are at home when onset of sepsis occurred), contributes to the higher case fatality rate (CFR)(CMACE 2011). The incidence of severe maternal morbidity and the CFR are summarised in Table 2.3 based on data provided by Waterstone et al. (2001), Penney et al. (2007) and Knight (2008b).

Table 2. 3 Incidence of severe maternal morbidity and the case-fatality rate (CFR)

		Morbidity ratio: MR / 10,000 deliveries [a,b] or maternities [c] (95% CI)	
		Higher Incidence	Lower Incidence
Case Fatality Rate: CFR (95%CI)	Higher CFR		• Sepsis [a] MR: 4 (2 - 6)/10000, CFR: 17.6% • Massive pulmonary embolism [b] MR: 0.7 (0.4 – 1.3)/10000, CFR: 4 - 9% [d] • HELLP syndrome [a] MR: 5 (3 - 8)/10000, CFR: 4%
	Lower CFR	• Severe pre-eclampsia [a] MR: 39 (33 - 45)/10000, CFR: 0% • Severe haemorrhage (blood loss > 1500ml)[a] MR: 67 (60 - 75)/10000, CFR: 0.3% • Severe haemorrhage (blood loss ≥ 2500ml)[b] MR: 45 (42 - 48)/10000, CFR: 0.3%	• Eclampsia [c] MR: 2.7 (2.4 - 3.1)/10000, CFR: 0% (0 - 1.7%)

a) Waterstone et al. (2001), 95% CI is not available.
b) Lennox and Marr (2010), Lennox (2011), CFR 95% CI is not available.
c) Knight (2007a)
d) The estimation of CFR is from Kyrle and Eichinger (2008)

These data suggest that the most frequent severe maternal morbidities a woman is likely to survive are haemorrhage and hypertensive disorder (i.e. pre-eclampsia/ eclampsia/HELLP syndrome). The definition and the trends of these higher incidence conditions associated with severe maternal morbidity are discussed in the next section.

2.4 Severe maternal morbidity with higher incidence

As described earlier, the Scottish audit of severe maternal morbidity indicated that, despite there being a relatively well-managed medical emergency in terms of saving women's lives, major obstetric haemorrhage remains the most common form of severe maternal morbidity. In a review of maternity services in England and Wales, the Healthcare Commission (now the Care Quality Commission) identified that postpartum haemorrhage (PPH), severe conditions of hypertensive disorders, and transfer of the mother to an ICU were indicators of severe maternal morbidity associated with risk of maternal mortality (Healthcare Commission 2008). There are however issues related to definitions and classification of all three indicators. In this section, the definitions of each condition are reviewed, followed by the incidence and the recent trends of these events.

2.4.1 Postpartum haemorrhage (PPH)

2.4.1.1 Definition and classification of PPH

The importance of a clinically relevant definition and classification of obstetric haemorrhage, in particular PPH, has been increasingly recognised by clinicians. Coker and Oliver (2006) summarised the reasons as follows: (i) to identify the most

suitable line of management; (ii) to determine the prognosis which may help to predict the immediate, medium, and long-term clinical outcome; and (iii) to facilitate effective communication between clinical teams (e.g. call a senior or consultant doctor immediately).

Currently, there is no single, standardised definition of PPH (Rath 2011). The most widely used definition of postpartum haemorrhage is that used by the World Health Organisation (WHO) as “a loss of 500 ml or more from the genital tract after delivery” (WHO 2008, p.49). PPH is further classified by WHO according to the timing of the onset of bleeding: primary PPH is defined as “excessive bleeding occurring within 24 hours of delivery” and secondary PPH as “excessive bleeding occurring between 24 hours after delivery of the baby and 6 weeks postpartum (WHO 2008, p.49). This definition is also used in the Royal College of Obstetricians and Gynaecologists guideline on PPH (RCOG 2009).

Mousa and Alfirevic (2007), reviewing literature on treatment for primary postpartum haemorrhage, identified alternative cut-offs for primary postpartum haemorrhage, including blood loss ≥600 ml (Beischer and Mackay 1986), 1000 ml (Burchell 1980), and 1500 ml (Mousa and Alfirevic 2002). Because blood loss at a caesarean section is generally greater than at a vaginal birth, some definitions of PPH take the mode of birth into account (EUPHRATES Group 2005; Knight et al. 2009a). The WHO International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (WHO ICD-10-AM) defined PPH as a blood loss of ≥500ml for a vaginal birth and ≥750ml for caesarean birth (Lain et al. 2008; National Centre for Classification in Health 2002). PPH was coded using ICD-10 in the Canadian National Population Health Survey, if blood loss exceeded 500 ml after a vaginal birth and 1,000 ml after a caesarean birth or if the physician made a

notation of PPH in the medical record (Joseph et al. 2007; Knight et al. 2009a). The American College of Obstetricians and Gynecologists (2006) also defined PPH as blood loss of ≥ 500ml for a vaginal birth and ≥1,000ml for a caesarean birth. However, Knight et al. (2009) suggested that the use of a unified definition, irrespective of the mode of birth, is more appropriate, since there is no reason to believe that the physiological impact of blood loss differs according to the mode of birth.

For severe obstetric haemorrhage, Waterstone et al. (2001) and Penney et al. (2007) used blood loss cut-offs of ≥ 1500ml and ≥ 2500ml, respectively, as described earlier. In a recent Cochrane review on *Active versus expectant management for women in the third stage of labour* (Begley et al. 2011b), severe primary PPH was defined as a blood loss in excess of 1000 ml, with very severe primary PPH being loss of 2500 ml at time of birth and up to 24 hours.

The clinical implication of a classification based solely on blood loss is limited. Firstly, there are individual differences in response to blood loss reflected by general health state of a woman, the speed of the blood loss, her haemoglobin levels and coagulation system (Begley et al. 2011b; Coker and Oliver 2006). It is postulated that the majority of healthy pregnant women could tolerate acute blood loss up to 1000ml or more without significant haemodynamic problems (Rath 2011; RCOG, 2009), while a loss of 250ml may cause haemodynamic instability in women with severe anaemia (Rath 2011) or in women with a smaller body mass as they have lesser total blood volume (Mane and Ramarajan 2011).

Secondly, there is a difficulty in the accurate measurement of blood loss. Common reasons for this include that the bleeding is concealed within the uterus; that loss is

soaked up in linen, swabs, or pads or spilt onto the delivery room floor; or a woman experiences gradual blood loss over a period of time without recognition that this has occurred. As blood loss may be mixed with amniotic fluid, urine, or other fluids, this also may mask the true amount of blood loss (Glover, 2003, Rath, 2011, World Health Organization, 2003). The current worldwide standard clinical practice of postpartum blood loss assessment is based on visual estimation (Patel et al. 2006), although methods for this vary between settings, including drape estimation (using a simple blood collector bag) and weighing all blood-soaked sponges using sensitive weighing scales (Coker and Oliver 2006; Rath 2011).

Earlier studies consistently show that visual estimates almost always underestimate actual blood loss compared to an objective measurement such as calibrated drape or weighting, or laboratory-based measurement. In a small pilot study using simulation stations in an Australian hospital where delivery blood simulations were set up, Glover (2003) demonstrated that midwives and other health professionals underestimated blood loss by 30-50% based on subjective assessment. In addition, in a randomised controlled trial of 123 women who had a vaginal birth in a district hospital in India, visual estimates of vaginal blood loss were shown to be 33% lower compared to use of a calibrated drape estimation. Earlier studies also showed that the magnitude of underestimation increased as the actual amount of blood loss increased (Duthie et al. 1991; Glover 2003; Levy and Moore 1985; Toledo et al. 2007).

The American College of Obstetricians and Gynecologists (1989) attempted to overcome the limitations of the definition and classification of PPH based on the amount of blood loss by advocating the definition of PPH as a substantial drop in the haematocrit (i.e., a 10% or more change in haematocrit between the antenatal

and postpartum periods), or a haemorrhage which requires immediate blood transfusion. Using management-based criteria for severe PPH, some studies such as the UK Obstetric Surveillance System (Knight 2007b; Knight et al. 2009a) and the nationwide register-based population studies in Canada and Australia examined PPH requiring hysterectomy. However, the definition and classification of PPH based on haematocrit change or the management process (either hysterectomy or blood transfusion), has limitations (Coker & Oliver 2006). For example, change in haemodynamics/haemocrit is not clinically useful in an emergency situation because acute blood loss is not reflected by a decrease in haematocrit or haemoglobin concentration for four hours or more, and the peak decline may only be appreciated on day two or three postpartum (Kodkany and Derman 2006; Rath 2011). The antenatal value of haematocrit or haemoglobin may also not be available for some women.

A management-based definition of PPH, such as the need for hysterectomy or blood transfusion, or the number of units of blood for transfusion alone, are of limited value to the clinician attempting to treat primary PPH, as this can only be used retrospectively (Cameron and Robson 2006). The practice of blood transfusion may vary according to local circumstances (availability of blood) and attitudes toward blood transfusion (fears regarding the safety of blood products) among both patients and physicians (Currie et al. 2009; Rath 2011; Say et al. 2009). Earlier studies have also highlighted the issue of women who refused blood transfusions for religious reasons and subsequently die from haemorrhage (CMACE 2011; Van Wolfswinkel et al. 2009).

Coker & Oliver (2006) suggested that the ideal classification of PPH should take into consideration both volume of blood loss and the clinical signs and symptoms related

to such loss. The Royal College of Obstetricians and Gynecologists (RCOG) guideline on *Prevention and management of postpartum haemorrhage* (RCOG 2009a) proposed that a blood loss of 500 – 1000ml with no clinical signs of shock should be considered as minor obstetric haemorrhage, whereas blood loss of more than 1000ml or clinical signs of shock (tachycardia, hypotension, tachypnoea, oliguria or delayed peripheral capillary filling) should be considered as major obstetric haemorrhage where a full protocol of resuscitation, monitoring, investigation and treatment are prompted simultaneously. The RCOG guideline on responsibility of consultant on-call (RCOG 2009b) also considers PPH of more than 1500ml as an 'emergency situation' when a consultant should attend in person, whatever the level of the trainee (CMACE 2011). Benedetti (2002) and Coker and Oliver (2006) suggested that a blood loss more than 2400ml causes profound shock that can leads to mortality if not managed actively. Table 2.4 details the clinical signs and symptoms related to the volume of blood loss, as summarised by Bonner (2000).

Table 2. 4 Clinical signs and symptoms related to blood loss volume

Blood volume loss (ml)		Blood pressure	Symptoms and signs	Degree of shock
500-1000	(10-15%)	Normal	Palpitations, dizziness, tachycardia	Compensated
1000-1500	(15-25%)	Slight fall	Weakness, sweating, tachycardia	Mild
1500-2000	(25-35%)	70-80 mmHg	Restlessness, pallor, oliguria	Moderate
2000-3000	(35-45%)	50-70 mmHg	Collapse, air hunger, anuria,	Severe

Source: Bonnar (2000)

From the literature referred to above it is clear that there is a lack of agreement as to the definition of PPH. However, there appears to be a consensus that blood loss around 2500ml or more is considered to be potentially life-threatening. Since severe maternal morbidity is a condition that can develop into a 'life-threatening complication' if it is not promptly managed (Ronsmans and Filippi 2004), blood loss

exceeding 1000ml or 1500ml which in general involves some clinical signs of shock, appears to be an appropriate cut off for severe PPH, as adopted by previous researchers (Begley et al. 2011b; Waterstone et al. 2001) and clinical guidelines (RCOG 2009a, RCOG 2009b). The management-based definition of PPH (hysterectomy and the number of units of blood for transfusion) is also a marker of the severity of PPH and provides a way to identify women with severe maternal morbidity (Knight 2009), although it has a limited clinical value as described earlier. Severity of PPH is, on the other hand, difficult to identify using coded data.

2.4.1.2 Incidence and trend of PPH

A number of studies have observed an increasing trend in the incidence of PPH in high resource countries, despite use of heterogeneous definitions (Knight et al. 2009). In this section, the incidence of postpartum haemorrhage is described according to the definition and level of severity of postpartum haemorrhage.

Severe obstetric haemorrhage (estimated blood loss ≥2500ml or ≥1500ml + blood transfusion)

In the Scottish Confidential Audit of Severe Maternal Morbidity, major obstetric haemorrhage (MOH) was defined as an estimated blood loss ≥ 2500ml or blood transfusion ≥ 5 units. The audit showed an increase in incidence of MOH in Scotland from 3.7 per 1000 maternities (95% CI: 3.4-4.0) in the period 2003-2005 to 5.2 (95% CI: 4.6–5.8) per 1000 live births in 2009 (Lennox 2011; Penney et al. 2007). The latest Scottish Audit of Severe Maternal Morbidity also showed that the rate varied between hospitals from 2.7 (95% CI: 1.3–4.8) to 9.8 (95% CI: 7.2 -12.8) per 1000 live births (Lennox and Marr 2011). Of the MOH cases, 75% were attributed to postpartum haemorrhage, while rates of antepartum and intrapartum

haemorrhage were 9% and 16%, respectively. The most common causes of major obstetric haemorrhage were uterine atony (55%), followed by vaginal laceration/haematoma (20%) and retained placenta/membranes (19%) (Lennox 2011; Lennox and Marr 2011).

Using a lower threshold for severe obstetric haemorrhage (an estimated blood loss ≥ 1500ml or blood transfusion ≥ 4 units), Waterstone et al. (2001) estimated that the incidence of severe haemorrhage in the South East Thames region in 1998/1999 was 6.7 per 1000 deliveries (95% CI: 6.0-7.5). However, the incidence of severe obstetric haemorrhage was likely to be underestimated because women in their study who had more than one condition (such as severe pre-eclampsia and severe haemorrhage) were included only once in the incidence figures, and only the most severe morbidity was noted (Waterstone et al. 2001).

Postpartum haemorrhage (ICD codes, estimated blood loss ≥500ml, ≥750, ≥1000ml)

The most recent NHS Maternity Statistics for England showed that the incidence of PPH using ICD-10 code was 12% in 2010-2011 (NHS Information Centre 2011), up from 7.3% in 2005-2006 (NHS Information Centre 2007). This figure included any clinical diagnosis of PPH by a midwife or obstetrician, irrespective of the amount of blood loss (see Appendix 1 for further details regarding ICD-10 code for PPH in NHS). Similarly, the US national database, the Nationwide Inpatient Sample, showed that coded PPH using ICD-10 criteria increased from 2.3% to 2.9% between 1994 and 2006 ($p<0.001$) (Callaghan et al. 2010). However, in both surveys, it is not possible to verify the level of blood loss that led to the clinical coding for PPH. As described by the authors, PPH in the US is defined traditionally as an estimated blood loss of at least 500ml for vaginal birth and 1000ml for a

caesarean birth (Callaghan et al. 2010). On the other hand, the UK traditionally uses a unified definition of PPH (≥500 ml) (RCOG 2009a). Therefore, it might be possible that PPH might be diagnosed and coded differently using these criteria, contributing to the difference in the incidence of PPH between the UK and the US.

An increase in PPH over time has also been observed in Australia, Ireland and Canada. While these studies used ICD coded data on PPH, the case definition of PPH, which led to the clinical coding, was clearly mentioned in these studies. Coding practices are, however, different between studies, making the comparison of the incidence of PPH difficult. A retrospective population-based study in New South Wales in Australia, which involved a large sample of women (n=752,374) observed an increase in the incidence of postpartum haemorrhage from 4.9% in 1994 to 6.3% of deliveries in 2002 (Cameron et al. 2006). Using ICD-10-AM, PPH was defined as a haemorrhage of 500ml or more following vaginal birth and 750ml or more following a caesarean birth (Cameron et al. 2006).

Similarly, in a retrospective study based on a Canadian national database which involved almost all hospital births between 1991 and 2004, Joseph et al. (2007) observed considerable increases in the incidence of PPH (defined as blood loss after childbirth exceeding 500ml after a vaginal delivery and 1,000ml after a caesarean delivery or physician's notation of PPH in the medical records), from 4.1% in 1991 to 5.1% in 2004 (Joseph et al. 2007; Knight et al. 2009a). These increases were attributed primarily to increases in atonic uterine PPH.

A population-based retrospective cohort study in Ireland (Lutomski et al. 2012) also indicated a substantial increase in the rate of PPH in hospital-based deliveries between 1999 and 2009 (1.5% and 4.1%, respectively) using ICD coded data. PPH

was defined by clinicians according to local hospital policy, which in general followed the UK RCOG guidelines (ie. an estimated postpartum blood loss of more than 500 ml) (Lutomski et al. 2012). The increases in PPH were again primarily due to an increase in atonic PPH.

Management-based PPH (hysterectomy or blood transfusion)

As described earlier, obstetric haemorrhage can also be defined as haemorrhage that required complex medical procedures such as hysterectomy. Comparing the results of the population based study on haemorrhage-associated peripartum hysterectomy in South East Thames (Eniola et al. 2006) and the UK Obstetric Surveillance System, Knight et al. (2009a) found no significant increase in the rate of hysterectomy for managing peripartum haemorrhage between 1997-1998 and 2005-2006 in the UK. Similarly, the Australia study by Cameron et al. (2006) showed no significant change in rates of hysterectomy among women with PPH between 1995 and 2002, while the increase in haemorrhage led to a six-fold increase in blood transfusions among women who had PPH from 1.9% in 1994 to 11.7% in 2002 (Cameron et al. 2006). In Canada, there was an increase in the incidence of PPH-associated hysterectomy from 0.24 in 1991 to 0.42 per 1000 deliveries in 2004 (Joseph et al. 2007; Knight et al. 2009a). However, within the study, the incidence of postpartum haemorrhage with blood transfusion (one or more units) remained unchanged, implying a decline in the rate of blood transfusions for women with postpartum haemorrhage as an overall incidence of PPH increased over the study period. Comparing the results to those of Cameron et al. (2006), which showed the increase in postpartum haemorrhage led to an increase in blood transfusions but no change in rates of hysterectomy, Joseph et al. (2007) argued that there might be interventional differences for PPH due to preferences of clinician and patient between settings. For example, non-referrals for

blood transfusion might be related to Canada's recent history with regards to contaminated blood (Joseph et al. 2007). In Ireland, along with the increase in PPH, the rate of blood transfusion significantly increased from 4.7 in 1999 to 12.9 in 2009 per 1000 deliveries (Lutomski et al. 2012).

In summary, postpartum haemorrhage is not always distinguishable from other obstetric haemorrhages that occur in the antenatal and intrapartum settings. Studies also use different definitions of PPH which vary from the amount of blood lost to the management-based definition. However, these data consistently show an upward trend in incidence of obstetric haemorrhage at all levels of blood loss severity. Table 2.5 summarises the incidence of PPH (or obstetric haemorrhage) according to the definition used in each study.

Table 2. 5 Incidence of obstetric haemorrhage

Study population	Authors	Definition of obstetric haemorrhage	Study year	Sample size	**Incidence** - per 1000 births [a] /maternities [b]/ deliveries [c]/live births [e] (95% CI)
Severe obstetric haemorrhage (EBL≥2500ml + management-based PPH)					
Penney & Adamson (2007) Penney (2008)	Scotland	EBL≥2500ml or Transfusion≥5 units	2003-2005	159,223	3.7/1000[b] (3.37-4.0)
Lennox (2011)	Scotland	(as above)	2006-2008	174,430	4.6/1000[e] (4.3 - 4.9)
Lennox & Marr (2010)	Scotland	(as above)	2009	54,910	5.2/1000[e] (4.6 - 5.8)
Severe obstetric haemorrhage (EBL≥1500ml + management-based PPH)					
Waterstone et al. (2001)	England - South East Thames	EBL≥1500ml, Transfusion≥4 units, or Hb concentration≥40g/l	1997-1998	48,865	6.7/1000[c] (6.0-7.5)
ICD codes (EBL≥500ml, ≥750ml, ≥1000ml or clinician-defined PPH)					
Cameron et al. (2006)	Australia	EBL≥500 ml for vaginal birth EBL≥750 ml for caesarean birth or clinician-defined PPH	1994 2002	775,073 (over the study period between 1994 & 2002)	49/1000[c] 63/1000[c]
Joseph et al. (2007)	Canada	EBL≥500 ml for vaginal birth EBL≥1,000 ml for caesarean birth or clinician-defined PPH	1991 2004	274,580 239,936	41/1000[c] 51/1000[c]
Lutomski et al. (2011)	Ireland	EBL≥500 ml, clinician-defined PPH	1999 2007	49,334 72,901	15/1000[c] 41/1000[c]
ICD codes (clinician-defined PPH only)					
NHS Information Centre (2007)	UK	Clinician-defined PPH	2005-2006	593,446	73/1000[c]
NHS Information Centre (2011)		(as above)	2010-2011	668,195	120/1000[c]
Callaghan et al. (2010)	US	Clinician-defined PPH	1994 2006	10,481,197[†] (over the study period between 1994 & 2006)	23/1000[c] 29/1000[c]
Management-based PPH only					
Eniola et al. (2006)	England - South East Thames	Hysterectomy	1997-1998	48,865	0.45/1,000[c]
Knight et al. (2008)	UK	Hysterectomy	2005-2006	775,186 (estimated)	0.41/1000[a] (0.36-0.45)
Joseph et al. (2007)	Canada	Hysterectomy	1991 2004	274 580 239 936	0.24/1000[c] 0.42/1000[c]
		Transfusion≥1 unit	1994 2004	266 877 239 936	3.7/1000[c] 3.9/1000[c]
Zwart et al. (2008b)	Netherlands	Transfusion≥4 units, Embolisation or Hysterectomy	2004-06	358,874	4.5/1000[c]
Lutomski et al. (2011)	Ireland	Transfusion≥1 unit	1999 2009	49,334 72,901	4.7/1000[c] 12.9/1000[c]
Brace & Penney (2004)	Scotland	Transfusion≥5 units	2001-2002	51,165	1.9/1000[c]

Hb=Haemoglobin, transfusion=blood transfusion

2.4.1.3 Risk or factors associated with a rise in incidence of PPH

The National Institute for Health and Clinical Excellence (NICE) guidance for intrapartum care for the NHS in England and Wales summarised evidence of risk factors for postpartum haemorrhage into antenatal and labour risks (NICE 2007b). Antenatal risk factors were previous retained placenta or postpartum haemorrhage, anaemia (haemoglobin level below 8.5 g/dl at onset of labour), BMI greater than 35 kg/m^2, grand multiparity (parity 4 or more), antepartum haemorrhage, over distention of the uterus (e.g., multiple pregnancy, polyhydramnios or macrosomia), existing uterine abnormalities, low-lying placenta, raised maternal age (35 years or older). Risk factors in labour were induction of labour, prolonged first, second or third stage of labour, oxytocin use, precipitate labour and operative birth or caesarean section.

It is considered that the rise in incidence of postpartum haemorrhage can be explained partially by the increase in the number of women who carry such risk factors, although there are several other possible explanations. Cameron et al. (2006) considered that the increase may be attributed to changes in three main areas: changes in maternal characteristics, variations in obstetric practices, and the ascertainment and reporting of PPH. Similarly, in the Scottish Audit of Severe Maternal Morbidity, Penney et al. (2007) argued that a rise in major obstetric haemorrhage in Scotland might be as a result of improvements in case ascertainment and changes in the obstetric population: increasing numbers of mothers with complex medical conditions, increasing age at childbirth, increasing number of multiple pregnancies following assisted reproduction, and increasing number of caesarean birth with subsequent placenta praevia and accretae.

2.4.2 Hypertensive disorders of pregnancy

2.4.2.1 Definition and classification of severe pre-eclampsia / eclampsia / HELLP syndrome

Severe pre-eclampsia, eclampsia and HELLP syndrome are all important causes of severe maternal morbidity and maternal mortality, however there is no universal agreement regarding the definitions of the terms 'severe pre-eclampsia', 'eclampsia' and 'HELLP syndrome'.

Severe pre-eclampsia

Pre-eclampsia is a pregnancy-induced multisystem disorder of unknown cause, accompanied by symptoms such as hypertension and oedema (swelling) (Sibai et al. 2005). In general, pre-eclampsia is defined "as new hypertension (diastolic blood pressure of ≥90 mmHg (blood pressure 140/90 mmHg) and substantial proteinuria (≥0.3g in 24h) at or after 20 weeks gestation" (Steegers et al. 2010, p. 631). Pre-eclampsia is relatively common and usually of mild severity, affecting 2-10% of pregnant women (Duckitt and Harrington 2005). Only a small number of women develop life-threatening severe pre-eclampsia (RCOG, 2006, Waterstone et al. 2001). However, because severe pre-eclampsia can progress to many other serious life-threatening complications (including eclampsia, HELLP syndrome, maternal stroke, liver hematoma or rupture, cardiac arrest), a clear definition and criteria to differentiate 'mild' and 'severe pre-eclampsia' is considered to be important to facilitate an immediate decision regarding care.

There are various differences between the classification systems for severe pre-eclampsia; however Steegers et al. (2010) identified that, by reviewing the classification across countries, the main differences include the use of early-onset of

pre-eclampsia as a severity criterion and the definition of severe hypertension and proteinuria in pre-eclampsia (Steegers et al. 2010). In the UK, the RCOG (2006) defined severe hypertension as a diastolic blood pressure ≥ 110mmHg on two occasions or systolic blood pressure ≥ 170mmHg on two occasions, and that, together with significant proteinuria (at least 1 g/litre), this constituted severe pre-eclampsia (Tuffnell et al. 2005).

The definition of severe pre-eclampsia recommended by the latest NICE guideline for hypertension in pregnancy (NICE 2010) is pre-eclampsia accompanied by severe hypertension (diastolic blood pressure ≥110mmHg, systolic blood pressure ≥160mmHg) and/or with symptoms (e.g. severe headache, visual disturbances), and/or biochemical and/or haematological impairment (NICE, 2010). Similarly, the Society of Obstetricians and Gynaecologists of Canada (SOGC) (Magee et al. 2008) and American Society of Hypertension (ASH) (Lindheimer et al. 2008) used the definition of high blood pressure of systolic blood pressure ≥160mmHg and/or diastolic blood pressure ≥110mmHg, but they also recommend a use of early-onset pre-eclampsia as a severity criterion. The American College of Obstetricians and Gynecologists (ACOG 2002) and the National High Blood Pressure Education Program Working Group in the US define severe pre-eclampsia as high blood pressure of (≥110/160mmHg) and heavy proteinuria regardless of gestational age at onset (NHBOEPWG 2000). Steegers et al. (2010) argued that, because of rising concerns about risks of life-threatening condition such as maternal stroke at the lower threshold for blood pressure, the debate between setting the systolic blood pressure definition of severe hypertension at either 160mmHg or 170mmHg needs to be resolved. Table 2.6 summarises international and national comparisons of criteria for severe pre-eclampsia, which was updated from Steegers et al.'s (2010) work, adding information including the classification suggested by NICE (2010).

Table 2. 6 Comparison of classification of severe pre-eclampsia

	RCOG (2006)	NICE (2010)	NHBPEPWG (2000)	ACOG (2002)	ASH (2008)	SOGC (2008)
Country	UK	UK	US	US	US	Canada
Severe hypertension	110/170mmHg	110/160mmHg	110/160 mmHg	110/160mmHg	110/160mmHg	110/160mmHg
Heavy proteinuria	1 g/l	3g in 24 h	2g in 24 h	5g in 24 h 3g on 2 urine random sample	3g in 24 h	3–5 g per day
Gestational age at onset	Not defined	Not defined	Not defined	Not defined	<35 weeks	<34 weeks

RCOG=Royal College of Obstetricians and Gynaecologists, NICE, NHBPEPWG=National High Blood Pressure Education Program Working Group, ACOG=American College of Obstetricians and Gynecologists, ASH=American Society of Hypertension, SOGC=Society of Obstetricians and Gynaecologists of Canada

Eclampsia and HELLP syndrome

Eclampsia and HELLP syndrome (a syndrome involving haemolysis, elevated liver enzymes low platelets) are life-threatening pregnancy complications and are considered to be variants of severe pre-eclampsia. The most common definition of eclampsia is the occurrence of one or more convulsions associated with pre-eclampsia, where other causes of convulsion have been excluded (American College of Obstetricians and Gynecologists 2002; Bick et al. 2009; Douglas and Redman 1994; NICE 2010). The criteria for HELLP syndrome are debated but include “haemolysis as evidenced by an abnormal peripheral blood smear; platelet count of less than 100 x 109/L; serum aspartate aminotransferase (AST) value of greater than 70 U/L, serum lactate dehydrogenase value of greater than 600 U/L or total bilirubin value of greater than 1.2mg/dL.” (Mehta 2011, p.98).

2.4.2.2 Incidence

Severe pre-eclampsia

Zhang et al. (2005) compared the incidence of severe pre-eclampsia (including eclampsia, HELLP syndrome) between nine countries in Europe using the consistent definition of severe pre-eclampsia (110/160) adopted from the National

High Blood Pressure Education Programme Working Group report on high blood pressure in pregnancy[2]. The results showed a wide variation in the incidence of the severe pre-eclampsia, ranging from 6.4 per 1000 deliveries in Belgium and Hungary, and 6.0 in Italy to 2.0 in Norway and 3.0 in France. The incidence of severe pre-eclampsia in the UK was 4.7 per 1000 deliveries in a study by Zhang et al. (2005). Using the same data source as that used by Zhang et al. (2005), but with a slightly different definition of severe pre-eclampsia (110/170), Waterstone et al. (2001) showed an incidence of severe pre-eclampsia of 4.6 per 1000 deliveries in the UK South East Thames region in the period 1997 to 1998. The incidence of severe pre-eclampsia between 1997 and 2003 in Yorkshire was slightly higher (5.2 per 1000 births), but the definition of severe pre-eclampsia was not clearly stated in the report (Tuffnell et al. 2005) (Table 2.7).

Table 2. 7 Incidence of severe pre-eclampsia including eclampsia and HELLP

	Study population	Study year	Sample size	**Incidence** - per 1000 births [a] / maternities [b] / deliveries [c] (95% CI)
Waterstone et al. (2001)	UK - South East Thames	1997-1998	48,865	4.6 (--) [c]
Tuffnell et al. (2005)	UK - Yorkshire	1999-2003	210,631	5.2 (--) [a]
Zhang et al. (2005)	UK - South East Thames	1997-1998	48,865	4.7 (4.1-5.4) [c]
	Austria - Upper Austria	1996-1997	6,022	5.3 (3.6-7.5) [c]
	Belgium - Brussels	1996	17,042	6.4 (5.6-8.1) [c]
	Finland	1996	17,249	5.0 (4.0-6.2) [c]
	France - Champagne-Ardenne, Lorraine and Centre	1995	71,909	3.0 (2.6-3.4) [c]
	Hungary - Upper Danube	1995	13,667	6.4 (5.1-7.9) [c]
	Ireland - Cork	1996	1,800	5.0 (2.4-9.8) [c]
	Italy - Puglia	1996-1997	3,170	6.0 (3.7- 9.5) [c]
	Norway - Oslo	1995	3,010	2.0 (0.8-4.6) [c]

Note: (--) information not available

Eclampsia

Knight (2008a), in an overview of trends in eclampsia in developed counties, suggested that the incidence of eclampsia and maternal death following pre-eclampsia were declining. In the UK, incidence of eclampsia was 4.9 per 10,000

[2] Pre-eclampsia complicated by one or more of the following: 1) Hypertension greater than 160/110 mmHg, 2) Proteinuria greater than 2 g/24 h or +++ on dipstick, 3) Oliguria <60 mL for 2 successive hours or <500 mL/24 h, 4) Epigastric or liver pain 5), Headache and blurred vision, 6) Pulmonary oedema.

maternities (95% CI: 4.5–5.4) in 1992 according to the national survey on eclampsia (Douglas and Redman 1994). Using the same case definition[3], the UK Obstetric Surveillance System (UKOSS) estimated the incidence of eclampsia was 2.7 per 10,000 births (95% CI: 2.4–3.1) over a thirteen-month period from 2005 to 2006, nearly halving the incidence from 1992 (Knight 2007a; 2008a). Knight (2007a) considered that the reduction in incidence of eclampsia occurred because of better clinical management of severe pre-eclampsia according to clinical guidelines (eg. RCOG guidelines), including the use of magnesium sulphate. However, Knight (2007a) also identified that, despite the declining incidence of eclampsia in the UK, there was no significant change in perinatal mortality between 1992 and 2005. This finding was consistent with results of earlier randomised controlled trials by Eclampsia Trial Collaborative Group (Duley et al. 1995) and Altman et al. (2002), which established the efficacy of magnesium sulphate to halve the risk of eclampsia among women with severe pre-eclampsia, but not to reduce perinatal mortality (Knight 2007a).

The Scottish morbidity audit reported that the "decline in eclampsia in the UK as a whole has not been seen in Scotland, although the numbers remain small" (Lennox 2011, p.197). The incidence of eclampsia in Scotland for 2003-2005 was estimated to be 3.5 per 10,000 deliveries (95% CI: 2.6-4.5), while using consistent definitions[4] and methods, the corresponding figure for 2006-2008 was 2.8 per 10,000 deliveries (95% CI: 2.4-3.1 per 10,000) – 95% confidence interval was overlapping.

[3] Case definition of eclampsia (Knight et.al 2007): Any woman with convulsion(s) during pregnancy or in the first 10 days postpartum, together with at least two of the following features within 24 hours of the convulsion(s)

- Hypertension (a booking diastolic pressure of< 90 mmHg, a maximum diastolic of ≥90 mmHg and a diastolic increment of ≥25 mmHg).
- Proteinuria (at least + protein in a random urine sample or ≥0.3 g in a 24-hour collection).
- Thrombocytopenia (platelet count of less than 100 x 109/l).
- Raised plasma alanine aminotransferase concentration (≥42 IU/l) or an increased plasma aspartate aminotransferase concentration (≥42 IU/l)

[4] The definition used was the occurrence of "seizure associated with antepartum, intrapartum or postpartum symptoms and signs of pre-eclampsia" (Penney 2007, p.249).

In the Netherlands' national survey, Zwart et al. (2008a) reported a substantially higher incidence of eclampsia with 6.2 per 10,000 deliveries over a two-year period (2004/2006), twice the incidence reported in the UK over the similar study period (2005/2006). Zwart et al. (2008a) identified substandard care in many cases, indicating the need for critical evaluation of the management of hypertensive disease. Table 2.8 summarises the incidence of eclampsia in high-income countries. As in previous tables in this chapter, the denominator used was per 1000 to make the comparison of incidence easier.

Table 2. 8 Incidence of eclampsia

Authors	Study population	Study year	Sample size	**Incidence** - per 1000 births [a] /maternities [b]/ deliveries [c]/ live birth [e] (95%CI)
Douglas et al. (1994)	UK	1992	774,436	0.49 (0.45-0.54)[b]
Waterstone et al. (2001)	UK - South East Thames	1997-1998	48,865	0.2 (0.1-0.4)[c]
Tuffnell et al. (2005)	UK - Yorkshire	1999-2003	210,631	0.39 (0.31-0.48)[a]
Brace et al. (2004)	UK - Scotland	2001-2002	51,165	0.5 (--)[c]
Penney et al. (2008)	UK - Scotland	2003-2005	159,223	0.35 (0.26-0.45)[b]
Lennox (2011)	UK - Scotland	2006-2008	174,430	0.28 (0.20–0.36)[e]
Lennox & Marr (2011)	UK - Scotland	2009	59,046	0.25 (0.14-0.42) [e]
Knight (2007)	UK - all hospitals with consultant-led maternity units in the country	2005-2006	779,955 (estimated)	0.27 (0.24–0.31)[b]
(Andersgaard et al. 2006)	Sweden Norway Denmark	1998-2000	170 189 119 456 130 664	0.57 (--)[b] 0.52 (--) [b] 0.41 (--) [b]
Zwart et al. (2008a)	Netherlands – all obstetric units in the country	2004-2006	371,021	0.62 (--) [c]
Liu et al. (2011)	Canada	2003-2004	248,496	1.24 (1.11-1.39)[c]
		2009-2010	287,942	0.59 (0.50-0.69)[c]

Note: (--) information not available

HELLP syndrome

Few studies have investigated the incidence of HELLP syndrome. The estimates vary from 0.1 per 1,000 deliveries in the Netherlands between 2004 and 2006 (Zwart et al. 2008a) to 7.6 per 1,000 deliveries in a single tertiary referral medical centre in the US between 1981 and June 1997 (Martin et al. 1999). Waterstone et

al. (2001) provided an estimate of the incidence of HELLP syndrome for South East Thames region of 0.5 per 1000 deliveries in 1997/1998. Due to a lack of studies of the incidence and the risk factors for HELLP syndrome to date, the UKOSS is currently conducting such a survey but the result is not available yet (study period is from June 2011 to May 2012) (Knight et al. 2011; UKOSS 2012).

Table 2. 9 Incidence of HELLP syndrome

	Study population	Study year	Sample size (population)	Incidence - per 1000 births [a] / maternities [b] / deliveries [c] / live birth [e] (95%CI)
Martin et al. (1999)	US - University of Mississippi Medical Center	1981-1997	65,870	7.6[e]
Waterstone et al.(2001)	UK - South East Thames	1997-1998	48,865	0.5 (0.3-0.8) [c]
Zwart et al. (2008a)	Netherlands	2004-2006	371,021	0.13 (--) [c]

Note: (--) information not available

2.3.2.3 Risk factors for pre-eclampsia and eclampsia

Although pre-eclampsia cannot be prevented, the outcomes of pre-eclampsia such as maternal mortality and eclampsia have improved dramatically, due to improved antenatal care and early management including the therapeutic and prophylactic use of magnesium sulphate and inducing delivery when necessary (Knight 2007a; Verghese et al. 2012; Zwart et al. 2008a). Clinical management of pre-eclampsia involves early identification of pregnant women at risk of pre-eclampsia and preventing them from the development and deterioration of the disease (Knight 2007a; Verghese et al. 2012; Zwart et al. 2008a).

In a systematic review of risk factors for pre-eclampsia at antenatal booking, including 52 cohort and case-control studies, Duckitt and Harrington (2005) identified various factors associated with an increased risk of pre-eclampsia. The most significant risk factors for developing pre-eclampsia were a history of pre-

eclampsia and the presence of antiphospholipid antibodies. Other risk factors included BMI of ≥ 35 kg/m^2 before pregnancy or at maternity booking, pre-existing diabetes, nulliparity, a family history of pre-eclampsia, twin pregnancy and a systolic blood pressure ≥ 130mmHg at maternity booking. Women aged ≥40 years also had an increased risk of developing pre-eclampsia, whether they were primiparous or multiparous, while there was no evidence that young maternal age affect the risk of developing pre-eclampsia, whichever cut-off age was used. Similarly, the NICE antenatal care guideline (NICE 2008) indicated the risks of pre-eclampsia that may identified at the booking appointment include maternal age ≥ 40 years; nulliparity; pregnancy interval of more than ten years; family history of pre-eclampsia; previous history of pre-eclampsia; BMI ≥ 30kg/m^2, pre-existing vascular disease such as hypertension; pre-existing renal disease and multiple pregnancy.

Zwart et al. (2008a) identified that possible risk factors for developing eclampsia were multiple pregnancy, primiparity, younger maternal age (particularly ≤20 years), ethnicity (e.g. Sub-Saharan African immigrant) and obesity (BMI ≥30). However, Zwart et al. (2008) also identified that a large proportion of eclampsia cases in the Netherlands were potentially preventable with prophylactic use of magnesium sulphate as eclampsia often occurred after admission to the hospital for pre-eclampsia. Similarly, Andersgaard et al. (2006) reported that nearly half of the cases of eclampsia in their study in Scandinavian countries were potentially preventable by timely intervention such as systematic use of prophylactic treatment with magnesium sulphate. These findings indicated that sub-standard care was another important contributing factor for developing eclampsia.

In summary, developing severe maternal morbidity related to hypertensive disorders such as eclampsia largely depends on timely and appropriate clinical management

of the complication. It is crucial to prevent deterioration of pre-eclampsia particularly because, as Knight (2008a) pointed out, there may be an increase in pre-eclampsia in the future due to the rising number of women who carry the risk factors.

2.4.3 Admission to high dependency care

2.4.3.1 Classification and role of high dependency care

Admission to the ICU or coronary care unit (CCU) has been used as a management -based criterion for severe maternal morbidity in previous studies (Baskett 2008; Baskett and O'Connell 2005; James et al. 2011; Ryan et al. 2000). The ICU and CCU are high-end units which support patients with serious or life threatening morbidity (Ramarajan 2011). Although ICU admission is sometimes necessary for women who are critically ill, Ramarajan (2011) points out the disadvantages of pregnant women being admitted to general ICUs, which includes a forced disconnection between the women, her obstetrician and her immediate family; and which may therefore unsettle the women and her family. On the other hand, a high dependency care unit (HDU) is a critical care facility which is often located within the maternity unit with the advantage of concurrent expert obstetric and critical care management (Ramarajan 2011; Ryan et al. 2000). The HDU has been identified "as an intermediate level of care between the intensive care unit and the ordinary ward setting" (James et al. 2011, p.62), and so is often seen as a means of relieving pressure on ICUs (Baskett 2008; Kilpatrick et al. 1994). The existence of obstetric units with HDU beds should reduce the need for maternal transfer to medical intensive care by providing an appropriate facility to manage the most common obstetric causes of severe maternal morbidity such as haemorrhage and hypertensive disorder.

2.4.3.2 Incidence

Based on Scottish audit data, the ICU/CCU admission rates were 1.6 per 1000 deliveries in the period 2003-2005 (Penney et al. 2007) and 1.59 per 1000 live births in 2009 (Lennox and Marr 2011). The most frequent reason for ICU admission has consistently been for major obstetric haemorrhage. A total of 47% of women admitted to ICU in Scotland during 2003 to 2005 had major obstetric haemorrhage, while the corresponding figure for 2009 was 64%. However, Penney et al. (2007) noted that there was no concomitant increase in the numbers of women admitted to an ICU, despite recent increases in major obstetric haemorrhage. These results suggest "high dependency facilities within labour wards are absorbing this rise" (Penney et al. 2007, p.252).

In Ireland, Ryan et al. (2000) compared ICU admission rates before and after establishment of an obstetric HDU in one university hospital. Their results indicated that there was a clear trend towards decreased ICU admission rates following the establishment of an on-site obstetric HDU, although this was not a statistically significant difference. There was also a change in ICU referral practice following the advent of the obstetric HDU. The need for mechanical ventilation became the major indication for maternal ICU admission, while an increasing number of women with haemodynamic instability were managed within the HDU.

Keizer et al. (2006) examined the ICU admission rate in a single university medical centre in the Netherlands over twelve years and showed that women who required ICU admission constituted 0.76% of all deliveries during the same period. This rate is much higher than that reported by Zwart et al. (2008b), who reported an incidence of ICU admission of 0.24%. Keizer et al. (2006), found that the most common reasons for ICU admission were pre-eclampsia/eclampsia (62.0%) followed by

obstetric haemorrhage (18.3%). Zwart et al. (2008b) also reported that the main reasons for ICU admission were major obstetric haemorrhage (47%), hypertensive disorders of pregnancy (33%), respiratory complications (8%) and cardiac complications (7%).

There may be several reasons for this, including differences in study settings (a university tertiary hospital vs. all types of hospitals), study period (the Keizer et al's study covers twelve years), the availability of an HDU in hospitals and a small number of cases of ICU admission, resulting in less precision in the incidence of admission. Table 2.10 summarises the incidence of the ICU/CCU and HDU admission in relevant studies.

Table 2. 10 ICU/HDU admission rate

Authors	Study setting	Level of care	Study year	Sample size	**Incidence** - per 1000 births [a] / maternities [b]/ deliveries [c]/ live birth [e] (95%CI)
Brace et al.(2004)	UK - Scotland	ICU/CCU	2001-2002	51,165	1.30 (--)[c]
Penney et al.(2008)	UK - Scotland	ICU/CCU	2003-2005	159,223	1.60 (1.4-1.8)[b]
Lennox (2011)	UK - Scotland	ICU/CCU	2006-2008	174,430	1.46 (1.29-1.65)[e]
Lennox & Marr (2011)	UK - Scotland	ICU/CCU	2009	59,046	1.59 (1.29-1.95)[e]
Keizer et al. (2006)	Netherlands	ICU	1990-2001	18,581	7.6 (--) [a]
Zwart et al. (2008)	Netherlands	ICU	2004-2006	371,021	2.4 (--) [c]
Ryan et al. (2000)	Ireland	ICU (before HDU available)	1994-1996	14,096	0.8 (--) [c]
		ICU (after HDU available)	1996-1998	12,070	0.4 (--) [c]
		HDU	1996-1998	12,070	10.2 (--) [c]
Zeeman et al. (2003)	US	HDU	1998-1999	28 376	17.0 (--) [c]

Despite the recent increase in the overall incidence of severe maternal morbidity, earlier studies show no corresponding increase in the ICU admission rate. Many women traditionally admitted to ICU appear to be managed in obstetric HDUs where available. Therefore, estimation of the incidence of severe maternal morbidity solely

on the basis of admission to ICU may underestimate the true incidence of severe maternal morbidity.

2.4 Chapter summary

This chapter included reviews of the concept, definitions, and criteria of severe maternal morbidity as well as incidence, recent trends and associated factors. Although criteria used to measure severe maternal morbidity varied between studies, there was a trend in the rise in the overall rate of severe maternal morbidity in many high-income countries. Changes in the demographic characteristics of women who become pregnant in high-income counties are likely to lead to even higher rates of morbidity in the future, as highlighted by several researchers (Baskett 2008; Knight 2008a; van Roosmalen and Zwart 2009b). Pregnant women are more likely to be overweight or obese and many women are delaying childbirth leading to an increased risk of developing chronic health conditions that need greater medical management during pregnancy and labour (Knight 2008a; Knight et al. 2011; van Roosmalen and Zwart 2009b).

As the incidence of severe obstetric events is increasing so are the numbers of women who survive the event but subsequently develop chronic morbidity (Campbell et al. 1997). In order to provide appropriate care to minimise the potential impact of adverse outcomes, it is essential to understand women's subjective experiences of severe maternal morbidly. The clinical evidence reviewed here however relies on quantitative observational studies, which limits the understanding of deeper, contextual knowledge of women's subjective experiences about these conditions. The next chapter will therefore explore women's perceptions and

experiences of severe maternal morbidity and the potential impact of this on their lives, by reviewing qualitative literature.

Chapter 3

Women's perceptions and experiences of severe maternal morbidity - a synthesis of qualitative studies

3.1 Introduction

Previous chapters have shown that severe maternal morbidity has gained increasing attention as an important indicator of safety and quality in maternity care. There is now concern about increases in the rate of severe maternal morbidity in many developed countries (Baskett 2008). This is thought to be due to increased obstetric intervention and because pregnant women have complex medical needs (Baskett 2008; Knight 2008a). In high-income countries, postpartum haemorrhage and hypertensive disorders, which are frequently associated with maternal morbidity, are considered well-managed medical emergencies; the majority of women's lives are saved by prompt and appropriate medical intervention. However, general trauma literature shows that life-threatening events are likely to lead to psychological problems even when medical treatment goes according to plan and lives are saved (Vincent 2006). There is also a growing recognition that high level medical intervention during birth and women's memories and perception of birth may contribute to poor postnatal psychological outcomes (Astbury et al. 1994) including post-traumatic stress disorder, or PTSD (Creedy et al. 2000).

To minimise further adverse outcomes associated with an experience of severe maternal morbidity, women's perceptions and experiences related to the event should be included in any evaluation of maternity care (McDermott et al. 2004). This is because such evaluations could enhance future safety and quality of care and

improve women's experience of health services. This chapter therefore reviews qualitative studies with the aim of exploring women's perceptions and experiences of severe maternal morbidity and its potential impact on their lives. This chapter will be followed by a review of quantitative literature (chapter 4), which is informed by the issues identified in this qualitative literature review.

3.2 Methodology

A synthesis of qualitative studies was conducted in order to assemble knowledge from a range of disciplines on this topic. Qualitative studies identify issues from the individual women's perspectives and help interpret the meanings that they give to a particular behaviour or event, understand their experience of illness or disability and account for their use of health services (Hennink et al. 2011). A synthesis of qualitative research provides "a comprehensive picture of findings from individual studies" (Major and Savin-Baden 2010, p.33). It differs from a literature review because the emphasis is on analysing and interpreting findings across studies, rather than simply integrating the findings (Dixon-Woods et al. 2005; Erwin et al. 2011).

Following previous work by Malpass et al. (2009), the current review included three stages for synthesising qualitative studies: 1) systematic search, 2) critical appraisal, and 3) synthesis of findings from selected studies using techniques of meta-ethnography, which was originally proposed by Noblit and Hare (1988).

3.2.1 Systematic search

3.2.1.1 Searching process

Electronic searches were conducted on multiple bibliographic databases: MEDLINE, PsycINFO, EMBASE, CINAHL, British Nursing Index (BNI), Web of Science and Scopus. The search had three aims: 1) identify existing systematic reviews on women's experiences of severe maternal morbidity, 2) determine whether the current review would be necessary or need updating (if it had been done previously), and 3) identify primary qualitative studies for this review. Relevant literature was searched comprehensively using both thesaurus terms (e.g., the Medical Subject Headings: MeSH) and free-text keywords that referred to the exposure of interest (severe maternal morbidity), the outcome of interest (experience and impact of severe maternal morbidity), study population (women who had severe maternal morbidity), and study methodology (qualitative studies).

Search terms included 'maternal morbidity', 'maternal mortality', 'pregnancy complications' 'puerperal disorders', 'obstetric labo(u)r complication', 'postpartum h(a)emorrhage', 'obstetric h(a)emorrahge, 'eclampsia', 'pre-eclampsia', 'HELLP syndrome' 'pregnancy-induced hypertension' and 'uterine rupture'. The terms 'multiple organ failure', 'hysterectomy', 'high dependency unit' and 'intensive care unit' were also used in combination with the term to specify the study population such as 'pregnancy', 'labor, obstetric', 'birth', 'parturition', 'childbirth', 'postpartum' and 'postnatal'. In addition, broad based search terms related to the outcome of interest were used, such as 'experience(s)', 'feeling(s)', 'impact', 'view(s)', 'perception(s)', 'emotion(s)', 'survivor(s)', 'trauma'. Moreover, following previous researchers' searching strategies for meta-synthesis and meta-ethnography (Malpass et al. 2009; Shaw et al. 2004), text words and MeSH terms relating to

qualitative studies, such as ‘qualitative’ and ‘qualitative research’ were used to increase the search specificity.

All studies identified in the electronic search were first assessed for relevance by reviewing the titles, abstracts, and descriptor/MeSH terms. At this stage, each study was rated as ‘probably relevant’, ‘of uncertain relevance’ or ‘irrelevant’ using the inclusion/exclusion criteria listed below. Studies rated as ‘probably relevant’ or ‘of uncertain relevance’ were further assessed with the full texts. The electronic search was supplemented with a manual search of the cited reference in all ‘potentially relevant’ studies. Searches were completed in December 2011 and updated in March 2012.

3.2.1.2 Inclusion and exclusion criteria

The inclusion and exclusion criteria for this review are outlined in table 3.1, along with the rationales for these criteria described below.

Table 3. 1 Inclusion and exclusion criteria

Topic	Inclusion criteria	Exclusion criteria
Research focus	• Women’s experiences of severe maternal morbidity (e.g.., obstetric major haemorrhage, severe pre-eclampsia, eclampsia, HELLP syndrome) and it’s potential impact	• Women’s subjective experiences of birth in general or medical intervention which does not include information on severe maternal morbidity or did not assess severe maternal morbidity separately • Research in which participants were only selected from those who had a particular postnatal outcomes (e.g., PTSD, depression) regardless of their experience of severe maternal morbidity
Population	• Women who experienced severe maternal morbidity during labour and birth or immediately after birth	• Women who perceived their birth as 'traumatic birth’, which cannot be distinguished from an event of severe maternal morbidity • Research with health professionals who cared for women who experienced severe maternal morbidity
Setting/countries	• High income countries or urban areas of middle income countries where emergency obstetric care is available/accessible to majority of women, or • MMR < 50/10000 live birth	• Low income countries or rural area of middle income countries where emergency obstetric care is unavailable/inaccessible to the majority of women, or • MMR ≥ 50/10000 live birth
Study type	• Primary research • Studies designed to obtain in-depth qualitative data - either solely qualitative or mixed methods designs	• Qualitative data obtained from open-ended questions (written response data) in surveys • Opinion pieces, policy documents and books unsupported by raw data • Unpublished studies • Repeated findings originated from same study
Language	• English	• Non-English
Publication	• Published and grey literature	• None
Time frame	• Studies published after 1980	• Studies published before 1980

The inclusion criteria for this review included qualitative studies conducted with women who experienced severe maternal morbidity (i.e., obstetric major hemorrhage, severe preeclampsia, eclampsia, HELLP syndrome). Studies were excluded if they focused on women who perceived their childbirth as traumatic (eg. women who had emergency caesarean section or those whose baby required medical care following birth), but information was not provided regarding whether these women actually experienced severe maternal morbidity.

Qualitative data obtained using open-ended questions in surveys (e.g., written comments in self-administered questionnaires) were also excluded because of the difficulty obtaining in-depth and detailed information with such a study design (e.g. no opportunity to clarify a participant's statement) (Robson et al. 2001). Given that the focus of this review was high-income countries, particularly the United Kingdom postnatal population, studies originating from low income countries or rural areas of middle income countries were excluded because women's general health status is often low and because emergency obstetric care (i.e., emergency caesarean section and blood transfusion) is not universally available and accessible, both of which may affect the women's experience of severe maternal morbidity (World Health Organization 2011).

Where data on availability and accessibility of emergency obstetric care were not available, a maternal mortality rate (MMR) of more than 50 per 10,000 live births was used to assess whether findings were applicable to high-income settings. Information on the MMR was obtained from the World Health Organization and other national statistics records (Inter-agency health information network 2010; World Health Organization 2011). Only studies written in English were included

because the convention in these countries is to publish in English, and so papers in other languages were not sought. Publication years were restricted from 1980 to the 1st week of March 2012. The year 1980 was selected in order to reflect the recent obstetric practice in high-income countries. The inclusion of the studies was discussed with academic supervisors until consensus was reached.

3.2.2 Critical appraisal

For appraising the methodological quality of selected qualitative research, the Critical Appraisal Skills Programme checklist (CASP: Creedy et al. 2000) was used. This checklist is widely used and has been employed in previous syntheses of qualitative studies (Campbell et al. 2003; Dixon-Woods et al. 2007; Malpass et al. 2009)

3.2.3 Synthesis

As a means of synthesis, meta-ethnography was selected because this is a "well-developed method for synthesising qualitative data" (Britten et al. 2002, p.210) with "several advances, including its systematic approach combined with the potential for preserving the interpretive properties of the primary data" (Dixon-Woods et al. 2005, p.48). It is also useful where several studies have produced qualitative data on the same issue. Based on the technique of meta-ethnography originally described by Noblit and Hare (1988) the process of synthesis in the current review involves three steps: 1) determine how studies are related or dissimilar through a compare and contrast exercise; 2) translate studies into one another and 3) synthesise the translations (further described below).

Determine how studies are related or dissimilar

Each selected paper was first read and then re-read to identify the original author's interpretation (the second order constructs) that were illustrated by raw data from the papers (first order constructs), while 'preserving and maintaining the integrity and context of the original research' (Erwin et al. 2011, p.193). The purpose of this exercise was to gain initial ideas for how key phrases, themes, concepts, or metaphors presented by original authors were related within and across studies.

Translate the studies into one another

The next phase involved 'translating the findings of one study into another' as suggested by Noblit and Hare (1988). This process involved further comparison of the second order constructs across studies, examining similarities and interactions between them in the different studies (May et al. 2005). The process of translation was aided by listing the key themes and concepts on a table with the authors' own words or participants' own words when necessary. Campbell et al. (2003) and Public Health Resource Unit England (2006) suggest that this translation is idiomatic, meaning that the focus is on the translation of salient categories of meaning rather than on the word-for-word translation.

Synthesise the translation

The final phase involved a further refinement of the core themes of the studies which was done, as Noblit and Hare (1988) and Walsh and Downe (2005) suggest by 'synthesising the translations'. This process involves producing new concepts or interpretations by highlighting the different translations produced, and transcending these accounts into a new level of analysis.

Three strategies for translating and synthesising the studies were suggested by Noblit and Hare (1988): 1) reciprocal translation, when the results are similar and easily comparable, 2) refutational translation, when there are inconsistencies or the accounts are different, and 3) lines-of-argument, which aims to find a "whole among a set of parts' (Noblit and Hare 1988, p.63). In order to do this, an inferential argument is developed through a comparison of the studies, which is then integrated into a more comprehensive interpretation of the issue.

Most importantly, Malpass et al. (2009) argue that in meta-ethnography, the findings of the different research papers will be translated into a new level of analysis and so will therefore be 'interpretations of interpretations of interpretations' (Malpass et al. 2009, p.158). These can therefore be seen as 'third order constructs' (Britten et al. 2002).

3.3 Findings

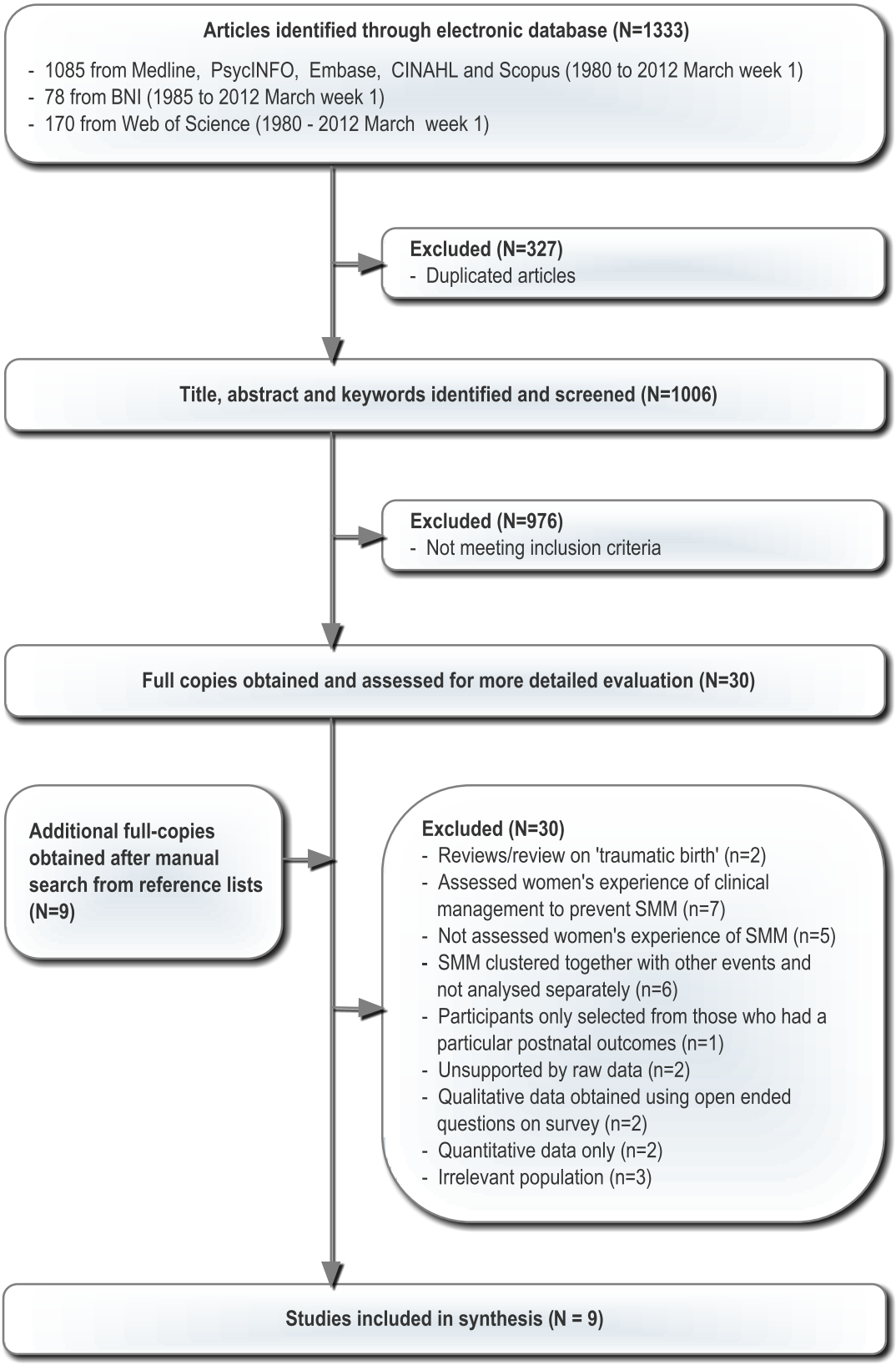
3.3.1 Searching

The search of the electronic bibliographic databases identified 1,006 studies after excluding the duplicated articles using the bibliographic software programme Endnote. The initial scoping review based on the titles, abstracts, and keywords revealed that 976 studies were irrelevant on the basis of pre-specified inclusion/exclusion criteria. Full-texts were obtained for the 30 studies. After checking references, an additional 9 studies were identified. Of the total of 39 studies, there were two meta-syntheses or meta-ethnographies that focused on perception and experience of 'traumatic birth' events (Beck et al. 2011; Elmir et al. 2010). However, the scope of 'traumatic birth' used in these papers was too broad to allow conclusions about severe maternal morbidity to be drawn and therefore a

synthesis of qualitative studies focusing on women's experience of severe maternal morbidity was considered necessary. Of the remaining, studies were further excluded for the following reasons: 1) The study focused on women's perception of medical treatment and care they received to prevent severe maternal morbidity; 2) The study focused on women's experience of other types of complication during pregnancy rather than severe maternal morbidity (e.g. hyperemesis gravidarum, diabetes), or fetal/neonatal prognosis with no information about severe maternal morbidity; 3) Severe maternal morbidity was clustered together with others types of obstetric events or perinatal diagnosis and not assessed separately; 4) Participants were only selected from those who had a particular postnatal outcomes; 5) The study findings were not supported by raw qualitative data; 6) qualitative data were obtained using open ended questions on the survey, 7) Only quantitative methods were used; and 8) Irrelevant population. Altogether, once the search criteria had been applied, a total of nine studies were included in the synthesis.

The study selection process is presented in Figure 3.1, and excluded studies are listed in Appendix 2.

Figure 3. 1 Study selection



3.3.2 Overview and critical appraisal of selected studies

Selected studies originated from UK (n=2), Australia (n=1), US (n=2), Netherlands (n=1), Sweden (n=1) and Brazil (n=2). The quality of these studies was appraised using the CASP checklist and none were excluded on the basis of poor quality. All studies had clear research aims and objectives. The majority of studies also adequately described the sampling method of participants, the data collection process during interviews, and analytical methods. The common limitation of these selected studies was however that the authors' roles and positions including their identity or background were not clearly discussed, and this can lead to potential bias during interpretation. In some studies, interviews were conducted in the hospital setting, which "may contribute to a possible courtesy bias, explaining the absence of criticism of the referral facility itself" (Souza et al. 2009, p.157). Moreover, almost all studies used a self-selected sample. Although it would not be ethical to seek to include women who did not feel comfortable talking about their experiences, it remains likely that self-selection leads to different and perhaps more conflicted experiences being missed by studies of this nature (Engstrom and Lindberg 2012; Kidner and Flanders-Stepans 2004).

A further issue is that the timing of interviews ranged between 2 weeks to 28 years following the experience of severe maternal morbidity (Elmir et al 2012), and the median reported time from exposure to interview was 4 years. Although Elmir et al. (2012) argued that time was not crucial because "most women who have experienced this event will have strong memories of the event even though several years may have elapsed" (Elmir et al. 2012, p.229), the practice of maternity care may have changed considerably over the intervening decades. Thus, interpretation requires caution.

Synopses of the selected studies are provided in Appendix 3. Methodological quality and characteristics of selected studies are presented in Table 3.2 and Table 3.3, respectively.

Table 3. 2 Methodological quality of selected studies

	Carvalheira et al. 2010	Elmir et al. 2012	Engstrom and Lindberg 2012	Jonkers et al. 2011	Kinder & Flanders-Stepans 2004
Was the research design appropriate to address the aims of the research?	Yes	Yes	Yes	Yes	Yes
Was the recruitment strategy appropriate to the aims of the research?	Unclear	Yes	Yes	Yes	Yes
Were the data collected in a way that addressed the research issue?	Yes	Yes	Yes	Yes	Yes
Has the relationship between researcher and participants been adequately considered?	Unclear	Yes	Unclear	Unclear	Yes
Have ethical issues been taken into consideration?	Yes	Yes	Yes	Yes	Yes
Was the data analysis sufficiently rigorous?	Yes	Yes	Yes	Yes	Yes
Is there a clear statement of findings?	Yes	Yes	Yes	Yes	Yes
How valuable is the research?	It provides information about women's perceived risk of severe maternal morbidity, the feeling and emotion at the time of their experience of it, and they ways of overcoming it	It offers an insight into women's feelings and emotions at the time of severe PPH and hysterectomy and its longer-term impact on their lives.	It provides information of women's experience during and after a complicated birth which lead to ICU admission.	It provides both native and immigrant women's perspectives on health care and development of severe maternal morbidity	It provides deep understanding of women's experience of HELLP syndrome.
Potential issues	Potential biases caused by the study's settings in the hospital.	Self-selected sample. The time of interview since experiencing the PPH and hysterectomy varied widely.	Self-selected sample	Authors' position is unclear. Their interpretation of women's voice appeared to be influenced by the obstetricians' perspectives who were involved in the study to assess women's perspectives on maternity care in comparison to their physicians' perspectives.	Self-selected sample

(Table 3.2 cont.)

	Mapp & Hudson 2005	Mapp 2005	McCain & Deatrick 1994	Souza et al. 2009
Was the research design appropriate to address the aims of the research?	Yes	Yes	Yes	Yes
Was the recruitment strategy appropriate to the aims of the research?	Yes	Yes	Unclear	Unclear
Were the data collected in a way that addressed the research issue?	Yes	Yes	Yes	Yes
Has the relationship between researcher and participants been adequately considered?	Yes	Yes	Unclear	Unclear
Have ethical issues been taken into consideration?	Yes	Yes	Yes	Yes
Was the data analysis sufficiently rigorous?	Yes	Yes	Yes	Yes
Is there a clear statement of findings?	Yes	Yes	Yes	Yes
How valuable is the research?	It provides women's 'lived experiences' of specific obstetric emergencies	It provides women's experiences of post obstetric emergencies	It provides women's experience of eclampsia.	It offers a deep understanding about women's emotional reactions to severe maternal morbidity and its potential impact on women's lives from both negative and positive aspects
Potential issues	Self-selected sample	Self-selected sample	The process of recruitment and interviews (who, where) were not described in details.	"The interviews were conducted in the hospital, which may contribute to a possible courtesy bias" (p.157)

Table 3. 3 Characteristics of selected studies

Source paper	County setting	Sample	Ethnicity	Recruitment process	Timing of data collection	Methodology	Data collection methods	Analytic method	Aim
Carvalheira et al. 2010	Brazil, Sao Paulo	A total of 16 women who experienced severe maternal morbidity (pre-eclampsia, haemorrhage, uterine rupture with hysterectomy)	Unclear	Eligible women invited by a researcher (unclear how and when)	After hospital discharge	Unclear	Face-to-face semi-structured interviews at the hospital after discharge Audio recording	Collective Subjective Discourse	'To understand severe maternal morbidity from the perspective of women who experienced it' (p.1187)
Elmir et al. 2012	Australia	A total of 21 self-selected women who had hysterectomies following a severe PPH	Australian	Media advertisement, poster and flyers in a range of location and public places	Median time since having the hysterectomy: 4 years (range: 2 weeks to 28 years)	Naturalistic inquiry	Face-to-face, email, or telephone semi-structured interviews Audio recording	Inductive analysis	To describe women's experiences of having an emergency hysterectomy following a severe postpartum haemorrhage (PPH).
Engstrom & Lindberg 2012	Sweden	A total of 8 self-selected women who stayed in an ICU following complicated delivery Purposive sample	Unclear	Eligible women invited by critical care nurses	1.5 to 3 months after childbirth and ICU admission	Unclear	Face-to-face, semi-structured interviews at the interviewees' homes or the researcher's work place	Thematic content analysis	"To describe the experiences of becoming a mother after a complicated delivery and a stay in an ICU" (p.64)
Jonker et al. 2011	Netherlands	A total of 50 women who met the pre-defined criteria of severe maternal morbidity (Zwart et al. 2008). Purposive sample	Immigrant (n=40) Native Dutch (n=10)	Sample drawn from nationwide survey of severe maternal morbidity (Zwart et al. 2008)	2-6 weeks after hospital discharge	Unclear	Face to face in-depth interviews at the interviewees' homes (n=46) or in hospital (n=4) Using interpreter when necessary Audio recording	Thematic analysis Grounded theory	To understand patient's perspective on the development of severe maternal morbidity To 'gain insight into ethnicity-related factors contributing to sub-standard maternity care and to explore the possible relationship between sub-standard care and severe maternal morbidity in immigrant' (p. 145)

Source paper	County setting	Sample	Ethnicity	Recruitment process	Timing of data collection	Methodology	Data collection methods	Analytic method	Aim
Kinder & Flanders-Stepans 2004	US	A sample of 9 self-selected survivors of HELLP syndrome	White (n=8) Hispanic (n=1)	Sample recruited an online support group	Mean time from delivery: 2 years	Phenomenology	Telephone interviews Audio recording	Grounded theory	"To describe the experience of mothers whose pregnancies were complicated with HELLP syndrome and to determine if such experiences could be clustered by common themes from which a model could emerge." (p.44)
Mapp & Hudson 2005	UK	A sample of 10 self-selected women who experienced an obstetric emergency within the last three years, including eclampsia (n=1), severe PPH (blood loss≥1500mls) (n=7)	Unclear	Trust's Press Office A local paper	Within 3 years after	Phenomenology	Interviews Face-to-face interviews at the interviewees' homes or in hospital Audio recording	Colaizzi's method Phenomenological approach	To provide descriptions of women's 'lived experiences' of specific obstetric emergencies and to provide the drill training research project with a depiction of how some women experienced these events" (p. 30)
Mapp 2005	UK	(Same as above)	(Same as above)	(Same as above)	(Same as above)	(Same as above)	(Same as above)	(Same as above)	(Same as above)
McCain & Deatrick, 1994	US	A total of 12 women who whose pregnancies were high-risk and resulted in births of preterm infants, and their partners (n=9)	White	Sample recruited in a tertiary-level nursery	10-66 days after the preterm births	Naturalistic inquiry	Interviews Place: unknown Audio recording	Grounded theory	"To describe the experience of high-risk pregnancy from the perspective of mothers and fathers" (p.421)
Souza et al. 2009	Brazil, Sao Paulo	A sample of 30 women who survived severe pregnancy complications and who were admitted to the ICU of a public university hospital	No restriction	Eligible women invited prior to hospital discharge (Unclear by whom)	Before hospital discharge	Unclear	Face-to-face, semi-directed interviews by a trained female interviewer in a private room in the hospital Audio recording	Thematic analysis	'To investigate women's experiences related to the burden of severe maternal morbidity' (p.149).

3.3.3 Synthesis

The synthesis involved three steps in order to obtain a more comprehensive understanding of women's experience of severe maternal morbidity. These were as follows: i) how studies are related or dissimilar (identifying similarities and differences between the study, ii) translate studies into one another, and iii) synthesise the translations.

3.3.3.1 How studies are related or dissimilar

Comparison revealed key similarities. For example, several studies focused on a specific type of severe maternal morbidity such as severe postpartum haemorrhage (Elmir et al. 2012), HELLP syndrome (Kidner and Flanders-Stepans 2004) and ICU admission (Engstrom and Lindberg 2012; Souza et al. 2009), whilst others covered different types of severe maternal morbidity (Carvalheira et al. 2010; Jonkers et al. 2011; Mapp 2005; Mapp and Hudson 2005; McCain and Deatrick 1994). Six studies sought to describe women's physical experiences (Carvalheira et al. 2010; Elmir et al. 2012; Kidner and Flanders-Stepans 2004; Mapp and Hudson 2005; McCain and Deatrick 1994; Souza et al. 2009). All of the studies examined women's feelings and emotions at the time of their experience of severe maternal morbidity except for the study by Mapp (2005) which focused on women's postnatal problems following emergency obstetric events. One study (Jonkers et al. 2011) examined differences between native and immigrant women in the Netherlands, looking at their experiences and views of the health care related to the development and treatment of severe maternal morbidity. There are thus both similarities and differences in the research focus as well as in the research findings. Therefore, all three strategies - reciprocal translation, refutational translation, and inferential argument suggested by

Noblit and Hare (1988) - were considered appropriate for translating and synthesising findings of selected studies.

3.3.3.2 Translating studies into one another

The second phase of analysis used the method of 'translating studies into one another' as highlighted by Noblit and Hare above. Table 3.4 includes these second order constructs identified from the ten studies, using the original authors' own words or a close paraphrase. These second order constructs were grouped into broader category.

Table 3. 4 Second order constructs

Temporal theme	Sub theme	Elmir et al. 2012	Engstrom & Lindberg 2012	Carvalheira et al. 2010	Jonker et al. 2011	Kinder & Flanders-Stepans 2003
Severe maternal morbidity as an event	Types	Severe PPH & hysterectomy	ICU admission	Any types	Any types	HELLP syndrome
	Aware/unaware		Aware that "the delivery could be complicated" (p.68)	"Aware of the problems" "Unexpected" (p. 1190) "Pregnancy was represented as risk of death"	Recognition of high risk	
	Medical intervention	Hysterectomy Transfusion	ICU admission	ICU admission		
Immediate reaction	Physical experience	Pain Out of body Blood loss "Out of body experience"		Loss of consciousness		Pain
	Feeling of being near death	"Being close to death" (p.230) "Body shutting down and almost dying" (p.230) "Disconnected from their body" (p.231) "Out of body experience"				
	Possibility or actual loss of baby		"Feared that their baby was dead or seriously ill" (p.67)	"The infant's fragile condition is responsible for feelings of Loss and…mourning" (p.1191)		
	Feeling about treatment and care	Pain and suffering Hysterectomy - "the realisation of never being able to have children, saddened and caused women pain and grief" (p231)	Some felt ICU was unknown, stressful environment, while others felt it was professional and efficient with its high technological equipment	Lack of information	Immigrant - a lack of information Native Dutch women – "pro-active attitude in interactions" "shared decision-making" (p.149)	"Betrayal by health care providers" "Whirlwind of activity" to save lives "Frustration" (p.50)
	Sense of Loss/failure	"A real sense of loss of control" – helpless and weak "No choice" about treatment (p.231)	"Missed having a 'normal' delivery" (p.68) "Feelings of loss, grief and distress" (p.68)	Loss of body image *"The opposite of everything I dreamed of" (p.1193)*	"Loss of the normal maternal experience" (p.47)	"Loss of the initial joy of motherhood" (p.49) "Bodies failed to meet their expectation" (p.49)

Temporal theme	Sub theme	Elmir et al. 2012	Engstrom & Lindberg 2012	Carvalheira et al. 2010	Jonker et al. 2011	Kinder & Flanders-Stepans 2003
	Fear of death	"Bleeding and fear" (p230) "Shocking, traumatic, and horrifying" (p.232)	"Being afraid of dying" (p.66)	"Fear of death, not only of themselves but also for their children" (p.1190) "Fear of losing the child" (p.1192)		"Intense fear that either they or their babies would die" (p.50)
	Concerns/worry related to death	Leaving" children behind to the unknown" due to their own death "emotional scar" (p.231)				
	Anger					Anger against own body and the medical provider
	Guilt	"Asked [God] for forgiveness" (p231)		"Guilt-feelings, due to the possibility of losing the child" (p.1191).		"Guilty about the baby and the event" (p.51)
	Spiritual faith	Helping women keep calm		"Overcoming problems" (1190).	Overcoming problems	"Encounters with angels or other spiritual being during delivery and recovery" (p.52)
Aftermath	Seeking cause	"why me?" (p.233)		"A severe maternal morbidity is represented as something associated with the mother's mistakes during the pregnancy" (p.1191).	Substandard care "played a role in the development of complications" (p.144) "Lack of knowledge of danger signs", "Language barriers" (p.148) (immigrant women)	"Delay of diagnosis" (p.50)
	Blame					
	Posttraumatic stress reactions/symptoms	"Reliving the trauma: flashbacks and memories" "Posttraumatic stress symptoms" (p.232)				
	Child care/social implications					
	Sense of gratefulness	"Grateful for surviving a life-threatening emergency" (p.231)		"The joy of being alive" (p.1190)		
	Inner growth					

(Table 3.4 cont.)

Temporal theme	Sub theme	Mapp & Hudson 2005	Mapp 2005	McCain et al. 1994	Souza et al. 2009
Severe maternal morbidity as an event	Types	Severe PPH, hysterectomy or eclampsia	Severe PPH, hysterectomy or eclampsia	Eclampsia	ICU admission
	Aware/unaware	"Instinctively aware that something was wrong" (p.32)		Sense of vulnerability Anxiety of deterioration and inevitability of premature baby	Unexpected
	Medical intervention		Hysterectomy HDU/ICU admission	Tocolytic therapy	ICU admission
Immediate reaction	Physical experience	*"Detached from my body" (p.33)* "Inexplicable pain" (p.33)		Seizure	Pain is disagreeable organic experiences Loss of consciousness
	Feeling of being near death	"Did not question their own mortality" (p.33)		"Give up" - "just let me die" (p422)	"Perception of the imminence of death and the transitoriness of life" (p.152)
	Possibility or actual loss of baby				"In mourning due to losing the baby"
	Feeling about treatment and care	"They had trust in the healthcare professional" (p.33)			
	Sense of Loss/failure	"Lack of control physically" (p.33)			"Superior Being who has control over the process" Loss of 'normality', "Frustration at losing an idealised gestation" (p.156) "Failure of normal birth" (p.153)
	Fear of death	"Real fear" (p.32) "Fearful for the baby's mortality" (p.33)			" Fear is extremely intense" (p.156) Terrifying and traumatic Fear of loss of their baby
	Concerns/worry related to death				Feeling of close to death "led to concerns with respect to their loved ones, particularly their children".
	Anger				
	Guilt				

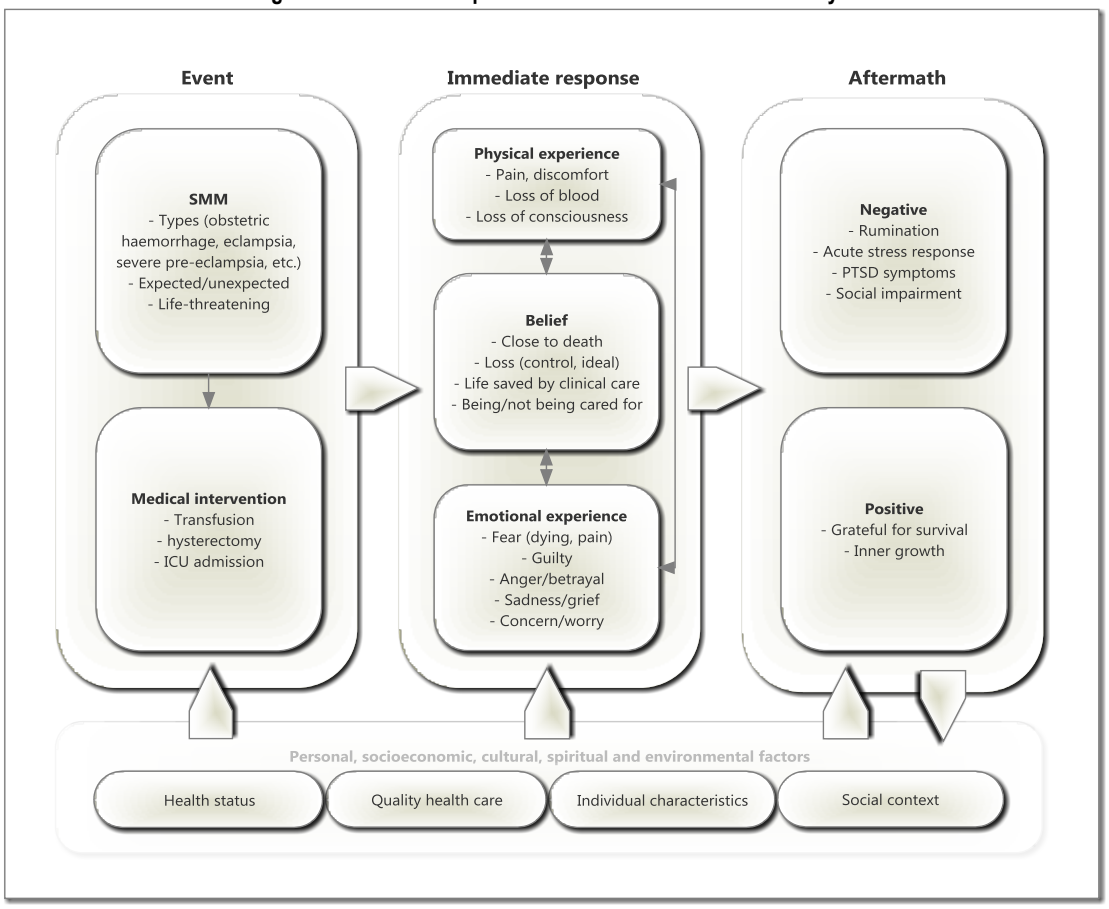
Temporal theme	Sub theme	Mapp & Hudson 2005	Mapp 2005	McCain et al. 1994	Souza et al. 2009
	Spiritual faith				"Only thing that many of the women could do under these circumstances and…brought them comfort"
Aftermath	Seeking cause		*'I don't really know why it happened' (p.37)*	Searching for cause	"Women criticized doctors and other health caregivers for not looking at them or listening to them" (p.157)
	Blame				"Sense of blame may be understood as a form of punishment" (p.155)
	Posttraumatic stress reactions/symptoms		"Shell shocked" (p.36)		"Cause post-traumatic stress disorder" (157) "Intrusive memory" "Acute stress disorder" (157)
	Social implications				"Long-lasting and the possible social implications" (p.152). "Hamper fulfilment of some of her social roles" (p.157).
	Sense of gratefulness				
	Inner growth				"Severe maternal morbidity as an opportunity for Inner growth"

3.3.3.3 Synthesising translations

Synthesis of the nine qualitative studies has shown that women's experiences of severe maternal morbidity can be broadly categorized into three areas: the event of severe maternal morbidity itself, the immediate reaction to the event, and the aftermath. Immediate reaction may be further broken down by physical experience, perception/interpretation of their situation, and emotion, which are all interconnected.

Aftermath may be divided into either negative or positive experience. The word pair 'negative/positive' were selected rather than such as 'disorder/order' or 'adaptive/maladaptive' because it is impossible from the current synthesis to determine if a particular symptom is a disorder or maladaptive. However, some symptoms are clearly negatively experienced by some individuals. For example, some psychological responses identified in the selected studies, such as acute stress symptoms may be considered as part of the 'problem-solving process' (Rosen and Frueh 2010), but they are perceived as negative symptoms for those who experienced them. The results of this synthesis showed that women's experiences of severe maternal morbidity may be influenced by other factors such as the individuals' personal characteristics, pre-existing health conditions, availability and accessibility of safety and quality health care, and wider social system. The results of synthesis of the selected studies are summarised in Figure 3.2 and further discussed below. Although in a synthesis of qualitative studies, the second order construct (interpretations of original authors) is the main subject of analysis and not the first order construct (patients' interpretations) (Sandelowski and Barroso 2007), the current synthesis included women's own words when these helped to provide a comprehensive picture of women's experiences of severe maternal morbidity and to minimise the risk of losing original meanings through layers of translation.

Figure 3. 2 Women's experiences of severe maternal morbidity



Severe maternal morbidity

For many women, the experience of severe maternal morbidity is a sudden and unexpected event (Souza et al. 2009). Elmir et al. (2012) argued that "childbirth complications such as severe PPH and emergency hysterectomy are rare; therefore…many women do not perceive themselves to be at risk of potentially life threatening complications" (Elmir et al. 2012, p.233). However, for some others, it may be within their 'expectations' and 'being prepared for the childbirth to be complicated' (Engstrom & Lindberg 2012, p.66), since some women saw their pregnancy as 'an event that put their lives and/or those of their children at risk' (Carvalheira et al. 2010, p.1190). For example, in a study by Carvalheira et al. (2010), a woman who had pre-eclampsia and eclampsia in her previous pregnancy

recalled her anxiety during her subsequent pregnancy—her perceptions of her susceptibility to severe maternal morbidity originated from her previous pregnancy and birth experience. Women sometimes also felt that 'something was wrong' (Kidner and Flanders-Stepans 2004, p.47), or felt vulnerable to severe maternal morbidity due to poor health conditions during pregnancy such as fatigue, headache and swelling of the legs (Jonkers et al. 2011; McCain and Deatrick 1994).

Whether or not severe maternal morbidly occurred unexpectedly may be partly explained by the type of severe maternal morbidity (postpartum haemorrhage often occurred suddenly, while some symptoms of pre-eclampsia often presented before developing eclampsia and HELLP syndrome). While women are often shocked and traumatised from a sudden and unexpected life-threatening complication, a prolonged sense of vulnerability to life-threatening complication may increase anxiety during pregnancy (McCain and Deatrick 1994).

Immediate reaction

Physical experience

There are a number of physical symptoms women may experience prior to or during severe maternal morbidity including pain, fatigue, headache and illness (Kinder & Flanders-Stepans 2003, Jonkers et al. 2011). However, women described critical illness in various ways. Some women talked about the shock at seeing a large pool of blood, while others were unaware of the severity of blood loss until they saw the number of blood transfusions they received (Elmir et al. 2012). Some women recognised that their lives were threatened while they were in theatre having a hysterectomy, while others went into a seizure (McCain and Deatrick 1994) and lost consciousness, waking up in the ICU without knowing what happened to them and the baby (Souza et al. 2009). Some women even had 'out of body' experiences with

a feeling of disconnection and distance from their body (Elmir et al. 2012; Mapp and Hudson 2005).

However their experience of critical illness went beyond reflections on life and death. For example, a woman in Souza et al.'s (2009) study perceived herself as abnormal when she noticed her body's appearance had altered and was very deformed due to gaining twenty kilos while being in a coma for several days due to eclampsia; she was distressed and worried about her husband's reaction to her appearance. In other cases, a woman who returned to theatre sometime after her caesarean section to have a hysterectomy due to heavy bleeding described her distress caused by surgical pain and reluctance to return to surgery, although she knew she had no choice if she were to survive (Elmir et al. 2012). Having to accept a permanent physical change (i.e., never being able to have children) as a consequence of hysterectomy gave rise to feelings of sadness and grief to some women. These physical experiences provoked negative sensations and emotion (Elmir et al. 2012; Souza et al. 2009).

Belief, interpretation and appraisal

- *Near death*

Women commonly had a 'perception of the imminence of death and the transitoriness of life' (Souza et al. 2009, p.152) and talked of 'being close to death' (Elmir et al. 2012, p.230) at the time of experiencing severe maternal morbidity. The feeling that death was near or imminent was frequently reinforced by the occurrence of disagreeable organic experiences, such as pain, dyspnea (Souza et al. 2009), bleeding (Elmir et al. 2012), and seizures (McCain & Deatrick 1994). The emergency obstetric care women received also influenced subjective judgments about the severity of their own illness and sense of death. For example, the near

death feeling sometimes resulted from or was exaggerated by admission to the ICU for women who held beliefs that “people…come here and don’t survive” (Souza et al. 2009, p.156). With a perception of being near death, some women even felt close to giving up their lives as shown in women’s words such as “just let me die” (McCain & Deatrick 1994, p422) and “I was willing to give up my life for the baby” (Kidner and Flanders-Stepans 2004, p.49). Women’s interpretation of feeling near to death was often accompanied by an emotion of fear of dying, which will be described later.

- *Feeling about care*

Women experienced mixed feelings related to the medical treatment they received to manage severe maternal morbidity. Although many women were grateful for life-saving treatment and care, treatment often involved physical and emotional pain and suffering. Women knew intellectually that the medical treatment was necessary for survival, but emotionally many of them found this necessity difficult to accept (e.g. Elmir et al., 2012). Positive feelings about care appeared to be reinforced if the women were involved in shared decision-making about the health care they received (Jonkers et al. 2011). In an emergency, women may feel they have *no choice* regarding what care they receive. However, even in emergencies, women often had clear memories of what their health care providers said, and women felt more positive about care when they were given an explanation by health professionals about the rationale for their medical procedure (e.g., why they needed a hysterectomy) (Elmir et al., 2012). However, despite the lack of explanations in emergencies, some women still felt safe if they trusted their health care professionals (Mapp and Hudson 2005).

The importance of nonverbal behaviour by health professionals during emergencies, (such as facial expressions, body language, and touch), was highlighted by Mapp

and Hudson (2005); good non-verbal communication helped make women feel humanised and reassured during the emergencies. On the other hand, women recalled being more distressed and frustrated when they felt isolated, ignored, treated inadequately, impersonally or unequally, or not listened to (Engstrom and Lindberg 2012; Jonkers et al. 2011).

Women often experienced negative feelings toward health care providers from the early stages of their complications. Thus, once their complications become severe and life threatening, they blamed delays in diagnosis on health professionals, which manifested as a strong sense of betrayal, with anger subsequently directed toward the health professionals (Kidner and Flanders-Stepans 2004). Cultural and language barriers appeared to contribute to these negative feelings (Carvalheira et al. 2010; Jonkers et al. 2011). Jonkers et al. (2011) stated that women's poor communication skills or poor health literacy was a contributor to substandard care saying, "immigrant women were often very modest about asking for medical attention or information about diagnosis and treatment" (p.149). However, these attitudes appeared to be a way for the immigrant women to show respect to their health care providers: "I try to respect the way things are here" (Jonkers et al., 2011, p.149). This illustrates differences in perceptions between health professionals and women regarding the maternity care that might have contributed to severe maternal morbidity.

- *Loss*

Women may have complex, varied, and multiple losses as a result of severe maternal morbidity. Kidner and Flanders-Stepans (2004) identified three sources of feelings of loss of control: over one's own body, medical decisions, and the event of life. Severe maternal morbidity often involves actual or potential loss of life and

health of self and/or the baby. With fear of dying, women often feel a loss of control along with a sense of 'helplessness', 'hopeless', and 'weakness'. The feeling of powerlessness may be seen in connection with the sense of 'not being able to influence what happened' or 'no choice' when having to make a decision for medical treatment (Elmir et al. 2012; Engstrom and Lindberg 2012). Some women may also feel that they do not have enough knowledge to influence medical decisions (Mapp and Hudson 2005). In some cases, decisions about care may be made by their husband or someone else. This situation was described by Souza et al. (2009) as an impression of a '…Superior Being who has control over the process, and the way in which the health care service operates' (p.153). In addition, women may experience the feeling of the loss of 'normality' and of the idealised pregnancy (Souza 2009, p.153), replacing it with a sense of 'failure' or thinking they are 'incompetent or incapable of performing the physical process of reproduction'. An experience of severe maternal morbidity could also give rise to a loss of positive body image as described earlier in the case of women who worried and/or grieved over an alteration of her body as a result of gaining her weight or in severe cases losing her uterus. Medical interventions, such as a hysterectomy, would affect future reproductive capacity of the women which could then result in a further loss. Thus women can experience a number of losses, which could affect their self-perception, and which may contribute to a loss of social interaction (Souza et al. 2009).

Emotion

- *Fear*

At the time of emergencies, women commonly used the words 'fear', 'shocking', 'frightening', and 'horrifying' to describe their emotions. Women often feared not only for their own lives but also for the lives of their babies (Carvalheira et al. 2010; Engstrom and Lindberg 2012; Kidner and Flanders-Stepans 2004; Mapp and

Hudson 2005; Souza et al. 2009). Although most women have the emotion of fear in the presence of severe maternal morbidity, the intensity of fear appears to vary among individuals. For some women, fear was relatively mild, while for others, it was intense (Souza et al., 2009).

Mapp and Hudson (2005) found that women's sense of fear during an emergency was sometimes perpetuated by seeing fear on health professionals' faces, while women felt more reassured by receiving a smile from their caregivers. They also found that some women did not question their mortality, even when they were objectively in the life-threatening conditions because they trusted in health care professionals, "who would behave in a certain way to care and help them," (Mapp & Hudson, 2005, p.33). The intensity of fear may thus be influenced by a woman's interpretation or appraisal of the life-threatening and impending danger (Power and Dalgleish 2008), which may be further influenced by many other factors, such as health care providers' behaviour (e.g., "a whirlwind of medical activity" appeared to increase fear) (Kidner and Flanders-Stepans 2004, p.47). Souza et al. (2009), on the other hand, considered fear to be the driving force behind a sensation of impending death. Fear and feeling near death may constitute a vicious circle in these situations.

- *Concern/worry*

Fear of dying and a near death sensation were related to familial concerns. Death meant that they would have to leave their baby and/or their other children behind to the 'unknown', not being with them as they grow up and not helping them face difficulty. This feeling was described by a woman in Elmir et al's. (2012) study as an emotional 'scar', particularly in the context of women being seen as the backbone of the family and the primary caregivers of their children.

- *Anger*

Anger was one of the common emotions among women who had HELLP syndrome in the study by Kidner and Flanders-Stepans (2004). In their study, some women expressed their anger toward their own bodies due to “being robbed of a great pregnancy and missing the joyous occasion of the desired birthing experience” (p. 50). Moreover, all of the participants in Kinder and Flanders-Stepans’ (2004) study described feeling anger toward the medical provider due to a delay in diagnosis or the rapid medical interventions, which created a sense of “not knowing and having no control” (Kinder & Flanders-Stepans, 2004, p. 50). Such a sense of anger may have longer term psychological impact.

- *Guilt*

Guilt was another common emotion among women who experienced severe morbidity (Carvalheira et al. 2010; Kidner and Flanders-Stepans 2004). A sense of guilt was especially strong in women who had a premature birth or whose babies died (Kinder & Flanders-Stepans 2004). A woman in the Carvalheira (2010) study expressed her feelings of guilt when she felt she might be possibly losing her baby with the words, ‘I'm killing my daughter’ (p.1191).

- *Faith and spirituality*

Studies highlighted the important role of spirituality and religious beliefs in overcoming problems during the experience of severe maternal morbidity (Carvalheira et al. 2010). In Elmir et al’s study (2012), spiritual faith and religion were seen as a way of helping women maintain calm and find comfort. Souza et al.

(2009) also reported that turning to 'faith was the only thing that many of the women could do under these circumstances and…[it] brought them comfort' (p.153).

Aftermath

Studies have shown that women who survive severe maternal morbidity have a number of long-term impacts, both negative and positive, although it is not possible from the current review to determine what length of time is 'long-term'.

Negative

- *Seeking causes – rumination and blame*

Women who survive severe maternal morbidity may have ruminative thoughts. In Elmir et al's (2012) research, women often asked 'why?' and 'why me?' in seeking the reasons for their hysterectomy experience. In Carvalheiva et al's. (2010) study, an experience of severe maternal morbidity was seen 'as something associated with the mother's mistakes during the pregnancy' (p.1191). Women who have a belief that the complication was a result of their own behaviour (e.g., not seeking health care on time or unhealthy life style) blamed themselves, seeing the event as form of a 'punishment' (Souza et al. 2009). When women were unable to find this kind of behaviour in their past, this aroused a sense of 'unfairness' or injustice. Some women also perceived severe maternal morbidity as an interpersonal event caused by substandard care. Apportioning blame to doctors or other caregivers was common as women perceived that their experience of complication was avoidable if they had received adequate care (Jonkers et al. 2011; Kidner and Flanders-Stepans 2004; Souza et al. 2009).

In the process of seeking to understand their experience of severe maternal morbidity, health care providers appeared to have an important role during the post-partum period. As shown in Mapp's (2005) study, women often expected health professionals to help them to make sense of their experience of severe maternal morbidity. However, routine postpartum care usually only focused on women's physical recovery and failed to meet their expectations, which caused further distress among women (Mapp 2005).

- *Reliving the trauma*

Following an experience of severe maternal morbidity, women may suffer from reliving the trauma even after several months and years, with the experience of flashbacks and nightmares (Elmir et al. 2012; Mapp 2005). Some environments may also trigger the memory of trauma (e.g., seeing pregnant women or hospital staff) and develop a hyperarousal state (Elmir et al. 2012). As a result, some women avoided visiting doctors and hospitals as these were reminders of their experience of severe morbidity and the treatment they received. This can be seen as an avoidance strategy, a common symptom of PTSD (Elmir et al. 2012). These symptoms indicated the possible link between women's experiences and acute stress disorder and/or PTSD (Souza et al. 2009).

Positive response

Women were however often grateful for surviving a life-threatening emergency and most of them managed to find something positive in their experience of severe maternal morbidity that would be an opportunity for their inner growth (Souza et al. 2009). The study by Souza et al. (2009) found that women viewed life after the event in a different way, appreciated life more than before, and tried to adopt a healthier lifestyle by giving up smoking and managing blood pressure. Some women

placed less value on material things, giving more value to things related to spiritual or religious beliefs and/or to their family and to people who were truly fond of them.

In summary, the studies contained many similarities regarding women's emotions during severe maternal morbidity, but there were also individual differences in some area in terms of perceptions of care and recovery processes, which may be influenced by health status before and during pregnancy, safety and quality of care, individual characteristics, support and social context. Possible issues influencing women's perceptions and experiences are further discussed below in relation to other literature and some theoretical perspectives drawn from social, psychological and behavioural sciences.

3.4 Discussion

The purpose of this synthesis of qualitative studies was to understand women's perceptions and experiences of severe maternal morbidity. The synthesis of nine qualitative studies has shown that women suffered physically and emotionally during severe maternal morbidity and that this was related to their critical illness and subsequent medical interventions to manage the condition. Women's physical, cognitive and emotional states during severe maternal morbidity and medical intervention are interrelated and it is difficult to draw a clear distinction between these when exploring women's experiences. However, all these experience have subsequent potential impact on maternal health and their lives in various ways both negatively and positively.

A common psychological state following severe maternal morbidity was ruminative thoughts. Wahl et al. (2011) described 'Why did this happen to me?' and 'Why can't

I handle things better?' as typical ruminative thoughts often associated with depression. Although rumination is a negative distressing experience for women, it may also be considered as a normal reaction following severe maternal morbidity. Janoff-Bulman (1985) suggested that by seeking the reason and cause of the trauma, many individuals are able to find the meaning of their experience and, by finding meaning, people become less psychologically distressed and socially better adjusted. However, those who are unable to make sense of their experience would have more insistent intrusive thoughts (Janoff-Bulman 1985). Some studies in the current review (Elmir et al. 2012; Mapp 2005; Souza et al. 2009) also showed that some women were re-experiencing the trauma (of severe maternal morbidity) in the various forms of intrusive memories, flashbacks, and nightmares. In addition, they often tried to avoid reminders which may in turn affect their social and occupational life. These reactions and symptoms may be seen as features of acute stress disorder (ASD) or post-traumatic stress disorders (PTSD), indicating a possible linkage of severe maternal morbidity with ASD and PTSD.

While severe maternal morbidity is often a negative experience for women, the current review also found that experiences of severe maternal morbidity could be an opportunity of inner growth which would have a positive impact on the women's subsequent lives (Souza et al. 2009). Thus, experience of severe maternal morbidity varies from person to person. There could be many reasons for the individual variations in these responses. One possible explanation is that varied personal characteristics, such as religion, ethnicity, and coping strategies, affected how women made sense of their experiences. For example, faith and religion were important coping mechanisms for some women.

Another possible explanation is related to whether or not severe maternal morbidly occurred unexpectedly. This synthesis found that severe maternal morbidity is a sudden and unexpected event to the majority of women. This indicates the perceived susceptibility of complications is low among many women (Elmir et al. 2012), although statistics shows that severe maternal morbidity is increasing. Literature on human cognition and emotion shows that sudden and unexpected event leads to more traumatic reactions than the event which was expected and prepared for (Power and Dalgleish 2008). Janoff-Bulman (1985) also propose that although we all recognise that serious diseases and accidents can happen, we operate our day-to-day life based on an 'illusion of invulnerability' or 'it can't happen to me'. In general, the belief of invulnerability 'protects us from the stress and anxiety associated with the perceived threat of misfortune' (Janoff-Bulman 1985, p.19), but people who have experienced a terrible event no longer perceive themselves as safe and secure, seeing their world as malevolent and themselves as weak, helpless, frightened, and out of control (Janoff-Bulman 1985; Janoff-Bulman 1992). PTSD is here seen as a maladaptive coping response to invalidation of these basic assumptions (Peterson et al. 1991).

On the other hand, women who have experienced severe maternal morbidity from a previous pregnancy or have witnessed this event in others close to them are then more susceptible to increased anxiety surrounding such a risk occurring (Carvalheira et al. 2010; McCain and Deatrick 1994). Birth preceded by a period of increased anxiety, aggravated by early maternal hospitalization may change 'the natural birth rhythm, provoking maternal feelings of despair, fear, and anxiety' (Andersen et al. 2012, p.2). This may be one explanation of variations in psychological and psychiatric symptoms following severe maternal morbidity.

Another explanation of differences during the aftermath could result from perceptions of what caused the severe morbidity. Even in cases in which the cause of severe maternal morbidity matched the initial clinical diagnosis, woman may view things differently. The current synthesis showed that women would often seek the cause of their experience of severe maternal morbidity from an inner source and interpersonal experience (e.g., unhealthy behaviour, doctors' attitudes toward the women). Earlier studies of PTSD indicated that interpersonal events, particularly potentially avoidable events, are much more traumatic and difficult to overcome emotionally than those events perceived to be an 'act of God' and unavoidable (Figley 1985). From the experience of patients who have been injured due to medical malpractice, Vincent (2006) pointed out that this impact differs from other traumatic events. He noted the two reasons:

> *Patients have been harmed, unintentionally, by people in whom they placed considerable trust and so their reactions might be especially powerful and hard to cope with. Second, patients are often cared for by the same professions, and perhaps the same people, as those involved in the original injury. As they might have been very frightened by what has happened to them, and have a range of conflicting feelings about those involved, this too can be very difficult. (p.124)*

Therefore, women who had negative feelings about health care professionals and believed that poor quality care played a part in their experience of severe maternal morbidity may have more troubles overcoming their experience. However, these negative feelings appeared to be relatively common among women who experienced severe maternal morbidity. For example, Kidner and Flanders-Stepans (2004) found most women in their study sample (US white women) expressed their anger and concern over the poor quality care they received. In the Netherlands, Jonkers et al. (2011) highlighted the issue of substandard care among immigrant

women, some of which was argued to have occurred as result of women's behaviour and poor health literacy, which hindered the doctor-patient interaction and use of health care. This was contrasted to the native Dutch women's proactive attitude of a shared decision making process for the health care they receive (Jonkers et al. 2011).

In Jonkers et al's (2011) study, it was thus considered that substandard care was largely attributed to women's poor health literacy and communication skills. However, criticism of the overemphasis on personal responsibility has been expressed by several authors, who express concern about the dangers of ignoring the social contexts. For example, Ryan (1976) introduced the rather provocative concept of 'blaming the victim', insisting that rather than resulting from individual behaviours, people's sorry conditions often resulted from the nature of the social system, which we now call 'structural violence'. Crawford (1977) also insisted that victim-blaming ideology ignores 'what is known about human behaviour and minimises the importance of evidence about the environmental assault on health' (p.671). This idea is particularly applicable to those with lower socioeconomic status in a society (Kessler 2000). Individuals are embedded in wider social systems in countries that may limit their opportunities to act on behalf of their own health, all of which affect women's access to high quality care which may in turn affect women's experience of severe maternal morbidity from the early stage of complications, through to their recovery process.

There could be many other explanations of the individual differences in the perception and experience of severe maternal morbidity. However, some of these reactions may be understood within cognitive models, provided by Green (1985) and Harvey (1996). Green et al.'s (1985) model shows how individual

characteristics and the recovery environment aftermath of trauma influence individuals' reactions to traumatic events and their recovery processes. The individual characteristics include: the person's appraisal of the stressor based on prior experience; pre-existing psychopathology; prior stress event that make a person more vulnerable; and coping mechanism. Environmental factors include: social support, 'trauma membranes' (family and friends), demographic characteristics, and the attitude of society. Social support here is viewed as either an individual characteristics or as a characteristic of the social system. More social resources may be available in a particular society and some individuals may make better use of such resources than others. The final aspect of the recovery environment, 'attitude of the society', is particularly important because the psychological effects of the traumatic event can be exacerbated when the traumatized person encounters a hostile environment where she/he expected a protective and welcoming one. This is what Silver (1986) described as 'sanctuary trauma'. Harvey (1996) also notes that an individual's reaction to traumatic events is influenced by the combined attributes of diverse communities (e.g., geographic, ethnic, linguistic, a professional, religious, or ideological) to which they belong and from which they draw identity.

In summary, individual perception and appraisal of severe maternal morbidity and the impact on their subsequent lives is possibly affected by their perception about the quality of maternal care and support during and after their experience of the event.

Implication for practice

The current review clearly indicates the need for safety and high quality maternity care to prevent and minimise the adverse impact of severe maternal morbidity. A

growing body of literature shows that health care systems can have a direct impact on the level of safety and quality of maternity care and subsequent obstetric outcomes (Healthcare Commission 2008; Smith and Dixon 2007). Communication difficulties and staff shortages have been repeatedly reported as factors which lead to women's unsatisfactory experiences of birth and in 'worst case' scenarios, can contribute to maternal deaths (Healthcare Commission 2008; Smith and Dixon 2007). During life-threatening emergencies, health care providers tend to focus on medical interventions to save a patient's life, giving little information to the patients (McSkimming et al. 1999). However, for these women even the medical management which saved their lives held much fear and other negative emotions; these emotions may even be exaggerated by poor communication with health staff and other environmental factors. Therefore, health service delivery at the time of the event could either mitigate or worsen the possible negative effects of severe maternal morbidity. Safe, high quality care is crucial not only for saving women's lives but also for reducing the negative perceptions and emotional experiences at the time of severe maternal morbidity, which may in turn contribute to poor life-long psychological and psychiatric outcomes.

Limitations of the review and future research

There are a number of limitations in this review. First, the synthesis was based on a very small number of studies which may not capture the whole picture of women's experiences of severe maternal morbidity. Second, the current synthesis included studies from Sao Paulo in Brazil, a middle-income state, where the health and social system may be very different to high-income countries. Although clear inclusion/exclusion criteria were set up prior to the review in order to make studies comparable, including maternal mortality ratio and accessibility of emergency obstetric care at the study setting, there still may have been limitations in

synthesising findings of the selected studies. Moreover, of the selected studies, there were variations in the timeframes covered in exploring women's experiences of severe maternal morbidity.

Finally, this synthesis excluded studies of the experiences of women if it was not clear whether they experienced severe maternal morbidity. However, earlier studies (Beck 2004, Ayers 1999) suggest that women who perceived their birth as 'traumatic' also developed PTSD, although it was objectively 'normal' (in the sense that no medical emergency occurred) or that it was a normal birth, without surgical assistance, suggesting that subjective experience and perception is important to the development of PTSD. Earlier studies also showed fetal or neonatal prognosis or obstetric complications, which are not considered as severe, cause anxiety and fear (Jackson et al. 2006; Price et al. 2007). Therefore it is not known how objectively measured severity of complications affects the subjective experience and outcomes. Further studies are needed to understand whether there is an increased risk of adverse postnatal outcomes such as PTSD among women who experienced severe maternal morbidity.

3.5 Chapter summary

In exploring women's perceptions and experiences of severe maternal morbidity, the current synthesis found that severe maternal morbidity is viewed by women who experienced it as a fearful, powerless, painful and/or life-threatening event, which deteriorated with inadequate clinical management and care, although many women still felt lucky to survive. This perception is different from the commonly used definition of severe maternal morbidity, namely: 'very ill, pregnant, or recently delivered women who would have died had it not been [for] luck and good quality

care' (Mantel et al. 1998, p.986). An experience of severe maternal morbidity and subsequent medical treatment are physically and emotionally distressing, conjuring negative feelings and emotions and possibly poor postnatal outcomes. Some negative psychological symptoms may be viewed as problem-solving processes in the aftermath of traumatic experience of severe maternal morbidity and recover with time passing. However, findings of this synthesis of qualitative studies suggest some women continuously suffer from re-experiencing trauma, avoidance and hyperarousal symptoms, indicating potential risk of PTSD. Further studies are necessary to better understand the link between severe maternal morbidity and PTSD symptoms. The next chapter therefore will examine evidence currently available on the relationship between severe maternal morbidity and PTSD symptoms.

Chapter 4

The relationship between severe maternal morbidity and post-traumatic stress disorder - a systematic narrative review

4.1 Introduction

A synthesis of qualitative studies of women's experiences of severe maternal morbidity in the previous chapter showed that some women may experience post-traumatic stress disorder (PTSD) symptoms following severe maternal morbidity. However, due to the nature of qualitative studies, it was not possible to examine potential associations between severe maternal morbidity and PTSD. This chapter reviews evidence from quantitative studies on the relationship between severe maternal morbidly and PTSD/PTSD symptoms.

PTSD is a condition an individual may develop in response to experiencing or witnessing a highly traumatic event. According to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria for PTSD, it involves a typical subjective response such as intense fear, helplessness, or horror. Symptoms of PTSD include hyper arousal, intrusion/re-experiencing, and avoidance/numbing (American Psychiatric Association 2000) (see Box 4.1, p.104). The onset of symptoms is usually rapid, occurring within the first week of the traumatic event (Rosen and Frueh 2010), but in a minority of cases there may be a delay of months or even years before symptoms start to appear (NICE, 2005).

Although the concept of PTSD was initially applied to survivors of combat, rape and assault, it has increasingly been acknowledged that childbirth can be a cause of PTSD (Bailham and Joseph 2003; Slade 2006). The prevalence of PTSD following childbirth is estimated to be 3% to 6% at around six weeks postpartum, decreasing to 1.5% at around 6 months postpartum (Olde et al. 2006). Whether the prevalence of PTSD is higher in a postnatal population than the general population is unclear, but PTSD during the postpartum period is an important public health issue because of the longer-term negative impact of maternal mental health problems on child development (Ayers 2007; Brockington 2004; Halligan et al. 2007) including impaired mother-infant relationship (Kumar 1997; Parfitt and Ayers 2009), delayed intellectual development (Hay et al. 2001; Sharp et al. 1995) and psychiatric disorder in children (Pawlby et al. 2008). Long-term maternal morbidity, if not identified or appropriately managed at an early stage, could increase use of health care services by women and their families (MacArthur et al. 2003; Waterstone et al. 2003). In one US general population study, Kessler (2000) reported that costs of PTSD to society are substantial because of individual life course consequences such as childbearing issues, marital instability and work loss, the main factors influencing welfare dependency in Western societies. Kessler suggested early outreach and treatment could help to reduce the enormous burden of PTSD to individuals and society (Kessler 2000).

Earlier reviews of PTSD following childbirth (Ayers 2004; Bailham and Joseph 2003; Olde et al. 2006; Slade 2006) identified a number of factors associated with PTSD and PTSD symptoms including pregnancy and pre-existing factors, delivery related factors and post-event environmental factors. Pregnancy and pre-existing factors include tocophobia (fear of labour), depressive symptoms during pregnancy, history of psychiatric and psychological problems, primiparity, unplanned pregnancy, trait

anxiety, history of sexual trauma, low self-efficacy and perception of low support. Labour and delivery related risk factors include mode of birth (i.e. emergency caesarean, instrumental delivery), partner not present, perception of low support from partner or staff, care factors (e.g. feeling poorly informed), high fear for self and/or baby, feelings of loss of control (powerlessness), negative gap between expectation and experience of severe pain. Post-event risk factors include the absence of available postnatal support and 'additional stress coping' (Ayers 2004; Bailham and Joseph 2003; Olde et al. 2006; Slade 2006). Little attention has been paid to understanding whether a woman experiencing a potentially life threatening health event during her pregnancy, labour, birth or immediate postnatal period is more likely to develop PTSD, resulting in an evidence gap to support provision of appropriate care for these women.

The primary aim of this review was therefore to assess the evidence systematically regarding a potential relationship between severe maternal morbidity occurring during pregnancy, labour and birth until the end of the first week postpartum and onset of postnatal PTSD.

Box 4. 1 DSM-IV criteria for PTSD

A: Stressor

- The person has experienced, witnessed, or been confronted with an event or events that involve actual or threatened death or serious injury, or a threat to the physical integrity of oneself or others.
- The person's response involved intense fear, helplessness, or horror

B: Intrusive recollection (1 or more)

- Recurrent and intrusive distressing recollections of the event, including images, thoughts, or perceptions.
- Recurrent distressing dreams of the event
- Acting or feeling as if the traumatic event were recurring
- Intense psychological distress at exposure to internal or external cues that symbolize or resemble an aspect of the traumatic event.
- Physiologic reactivity upon exposure to internal or external cues that symbolize or resemble an aspect of the traumatic event

C: Avoidant/numbing (3 or more)

- Efforts to avoid thoughts, feelings, or conversations associated with the trauma
- Efforts to avoid activities, places, or people that arouse recollections of the trauma
- Inability to recall an important aspect of the trauma
- Markedly diminished interest or participation in significant activities
- Feeling of detachment or estrangement from others
- Restricted range of affect
- Sense of foreshortened future

D: Hyper-arousal (2 or more)

- Difficulty falling or staying asleep
- Irritability or outbursts of anger
- Difficulty concentrating
- Hyper-vigilance
- Exaggerated startle response

E: Duration

- Duration of the disturbance (symptoms in B, C, and D) is more than one month

F: Functional significance

- The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning

American Psychiatric Association. (2000. p. 467-468)

4.2 Methods

To examine the relationship between severe maternal morbidity and postnatal PTSD, three specific review questions were developed:

1) Are there differences in the prevalence[5] and incidence[6] of PTSD and/or PTSD symptoms between women who experienced severe maternal morbidity and those who did not?
2) Is there a statistically significant relationship between severe maternal morbidity and PTSD and/or PTSD symptoms, and if so, how strong is that relationship?
3) Does the type of severe maternal morbidity affect the relationship between severe maternal morbidity and PTSD and/or PTSD symptoms?

Relevant literature were identified through electronic bibliographic databases which included; MEDLINE, PsycINFO, EMBASE, CINAHL, British Nursing Index (BNI), Web of Science, and Cochrane library. PhD theses were searched from the British Library. The search strategy was developed in consultation with an information specialist. The search terms included "post-traumatic stress disorder", "PTSD", "stress disorders, post-traumatic", “psychological distress”, “traumatic stress” “traumatic delivery” and “birth trauma”. Although the concept of “birth trauma” can include physical injuries, birth trauma in the context of this review refers to psychological trauma as suggested by Beck (2004). Keywords related to outcomes were searched in combination with search terms related to the exposure including "maternal morbidity", “pregnancy complications” “puerperal disorders”, "obstetric labo(u)r complication", "postpartum h(a)emorrhage", “hysterectomy”, "eclampsia", "pre-eclampsia", "HELLP syndrome" and “uterine rupture”. The term "multiple organ

[5] Prevalence quantifies “the proportion of individuals in a population who have the disease at a specific instance” (Hennekens et al., 1987, p.57)
[6] Incidence quantifies “the number of new events or cases of disease that develop in a population of individuals at risk during a specified time interval” (Hennekens et al., 1987, p.57)

failure" and terms for each criteria used in the Scottish Confidential Audit of Severe Maternal Morbidity such as "pulmonary (o)edema" and "coma" were also used in combination with the term to specify the population such as "pregnancy", “delivery, obstetric”, "labo(u)r, obstetric", "birth", “parturition”, "childbirth", "postpartum" and "postnatal". Subject headings (e.g MeSH) and free-text terms were used to maximize the sensitivity of the search. Terms were modified when necessary as each database used slightly different thesaurus terms. Restrictions were made to publications from January 1970 to August 2011 and only studies published in English were included. The year 1970 was selected because understanding the effects of trauma on psychotic symptoms dates back to at least the 1970s (Elhai et al. 2003; Friedman et al. 2007) which contributed to the official introduction of PTSD into the DSM-III in 1980 (American Psychiatric Association 1980). All studies identified in the electronic search were first assessed for relevance by reviewing the titles, abstracts and descriptor/MeSH terms. At this stage, each study was rated as "probably relevant", of ‘’uncertain relevance" or "irrelevant" using the inclusion/exclusion criteria listed below. Studies rated as “probably relevant" or of ‘’uncertain relevance" were further assessed with the full texts. The electronic search was supplemented by a manual search of the reference lists in all "potentially relevant" studies. Searches were completed on 14 Aug 2011.

4.2.1 Inclusion and exclusion criteria

The inclusion and exclusion criteria for this review are outlined in Table 4.1.

Table 4. 1 Inclusion and exclusion criteria

Topic	Inclusion criteria	Exclusion criteria
Research focus	• The relationship between severe maternal morbidity that occurred during pregnancy until the end of the first week postpartum and the onset of PTSD/PTSD symptoms within 2 years postpartum	• Studies of PTSD/PTSD symptoms associated with miscarriage and abortion • Studies of PTSD/PTSD symptoms associated with medical procedure or medical intervention per se (e.g. caesarean section) without including severe maternal morbidity as a predictor of PTSD/PTSD symptoms • Other postnatal psychological and physical problems • Studies of PTSD/PTSD symptoms in pregnant women not associated with pregnancy related events but with others such as conflict, accidents or natural disasters • Studies examining the effects of pre-existing PTSD/PTSD symptoms on future pregnancies
Population	• Women who experienced (severe) maternal morbidity (eg. Major obstetric haemorrhage, pre-eclampsia/eclampsia, HELLP syndrome, admission to intensive/special care unit)	• Childbearing women in general (of whom, women who experienced severe maternal morbidity not distinguishable)
Setting/countries	• No restriction made	• None
Study type/design	• Observational studies • Experimental studies with relevant data • Systematic reviews which examined the relationship between severe maternal morbidity and subsequent postnatal PTSD/PTSD symptoms	• Descriptive studies with no comparison group • Qualitative studies • Letter, commentary, news or short communications • Repeated findings originated from same study
Language	• English	• Non-English
Publication	• Published and grey literature	• None
Time frame	• Studies published from 1970	• Studies published before 1970

4.2.2 Data extraction

After initial screening of the titles, abstracts and descriptor/MeSH terms, the inclusion of the studies was discussed with my supervisors until consensus was reached. To support the critical appraisal of the methodological quality of each selected study, the Critical Appraisal Skills Programme (CASP) tools were used (Public Health Resource Unit England 2006). The review was written to reflect the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2009 checklist (Moher et al. 2009).

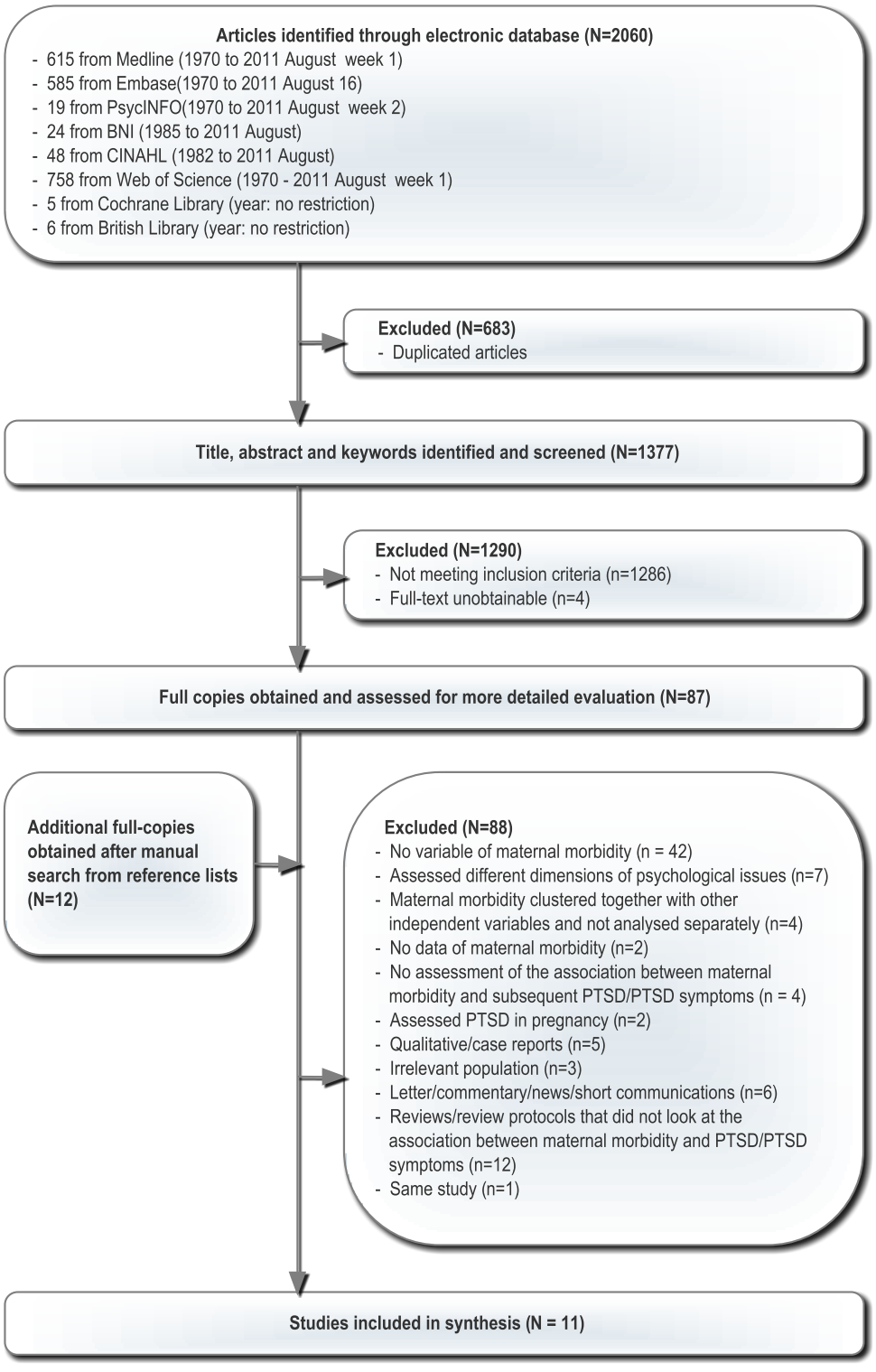
4.3 Results

4.3.1 Searching

The search of the electronic bibliographic databases identified 2060 studies. Of these, 683 were excluded after using the bibliographic software programme, EndNote (version X4), to identify duplicate articles. Initial screening based on a review of the titles, abstracts and keywords revealed 1290 studies not relevant on the basis of inclusion/exclusion criteria (e.g. examined physical birth trauma, ineligible population) or were unobtainable (paper not available). Full-text versions were obtained for the remaining 87 studies and an additional 12 studies were identified manually (total 99). After careful consideration, 88 studies were excluded. Reasons included that 1) there was no variable of maternal morbidity in analysis, 2) studies assessed different or broad dimensions of psychological and/or physical problems following maternal morbidity, 3) maternal morbidity was clustered together with other variables (e.g. socio-demographic, previous miscarriages) and not analysed separately, 4) maternal morbidity appeared to be assessed but no statistical data were provided, 5) studies reported or indicated the possibility of PTSD following maternal morbidity but the association between these two variables was not examined, 6) PTSD was assessed in pregnancy or the effects of pre-existing PTSD on pregnancy complications (e.g. miscarriage) were examined, 7) qualitative/case reports, 8) irrelevant population 9) the publication was a letter, commentary, news or short communication rather than a research paper and 10) a paper replicated findings based on the same study (published and unpublished) with the less informative publications excluded. Twelve systematic and narrative reviews were identified that looked at PTSD/PTSD symptoms during pregnancy or following childbirth or obstetric interventions. All studies included in these reviews were retrieved, but none provided relevant data, except for the study by Ayers (1999). A

total of eleven studies were included in the review. The study selection process is presented in Figure 4.1 and excluded studies are listed in Appendix 4.

Figure 4. 1 Study selection



4.3.2 Overview of selected studies

The characteristics of the eleven included studies are summarised in Table 4.2. Studies originated from Netherlands (n=5), Australia (n=2), Canada (n=1), the UK (n=1), the US (n=1), Israel (n=1) and Nigeria (n=1). There were six prospective cohort studies (Ayers 1999; Cohen et al. 2004; Creedy 1999; Hoedjes et al. 2011; Lev-Wiesel et al. 2009; Stramrood et al. 2010a), two retrospective cohort studies (Engelhard et al., 2002, Baecke et al., 2009) and three cross-sectional cohort studies (Adewuya et al. 2006; Sorenson and Tschetter 2010; Stramrood et al. 2011). Four cohort studies primarily aimed to examine PTSD or PTSD symptoms following maternal morbidity or 'difficult' birth (Cohen et al. 2004; Engelhard et al. 2002; Hoedjes et al. 2011; Stramrood et al. 2010a). Four studies (two prospective cohort and two cross-sectional) aimed to look at the prevalence and contributing factors related to PTSD or PTSD symptoms following childbirth in general (Adewuya et al., 2006, Ayers, 1999, Creedy, 1999, Sorenson and Tschetter, 2010). Three studies (two cohorts and one cross-sectional) originally aimed to examine the effect of other exposure of interest (i.e. delivery settings, past traumatic events) or different outcomes (i.e. cognitive function) but reported relevant data for this review (Baecke et al. 2009; Lev-Wiesel et al. 2009; Stramrood et al. 2011).

Table 4. 2 Characteristic of the included studies

Authors	Country	Design	Site	Size (follow-up)	Resp. Rate† %	Time of recruit-ment	Criteria		Maternal morbidity		PTSD		
							Inclusion	Exclusion	Type	Source	Time postnatal	Tool	Admini-stration
Adewuya et.al. 2006	Nigeria	Cross-sectional	Multi. clinic. (n=5)	876	95 [a]	Postnatal	Women attending 6 week postnatal & infant immunisation clinic	None	Hospital admission in pregnancy Manual removal of placenta	Self-report	6 wks	M.I.N.I.	Interview
Ayers 1999 (PhD thesis)	UK	Pros. cohort	Single hospital	245 (201)	70 -83 [c] (46-56 [a])	Antenatal	Gestational age 16≤, ≤ 36 wks at recruitment Good English	EICS Poor English Other research participation Moving out No fixed address Psychiatric inpatient	Blood loss Delivery complication	Clinical records	1 week 6 weeks 6 mths	IES PSS-SR	Postal
Baecke et al 2009	Netherlands	Retro. cohort	Single hospital	169	48-76 [b or c]	Postnatal	Pregnancy complicated by pre-eclampsia and control groups	Multiple pregnancy	Pre-term pre-eclampsia Term pre-eclampsia	Clinical records	6 -18 mths	IES	Postal
Cohen et al 2004	Canada	Pros. cohort	Multi. hospital (n=6)	198	60-87 [b or c]	Postnatal	Age≥18 Understand English Delivered a full-term Singleton infant	Poor English Child for adoption Risk of baby (multiple infant, premature, congenanomaly, NICU, death)	maternal complications (PPH, uterine infection UTI, or retained placenta etc.)	Not clear	6-8 wks	DTS	Interview (telephone)
Creedy 1999 (PhD thesis)	Australia	Pros. cohort	Multi. hospital (n=4)	499 (141)	73 [b]	Antenatal	Age≥18 3rd trimester pregnancy Understand English No major prenatal complication No medical problems healthy full-term infant	Risk of baby (premature, stillbirth) Pregnancy with high risk for birth complications	Delivery complication (PPH, anaemia, infection, severe post-delivery pain or manual removal of placenta etc)	Self-report	4-6 wks 3-4 mths	IES PSS-	Interview (telephone)
Engelhard et al. 2002‡	Netherlands	Retro. cohort	Single hospital	113	51-90 [b]	Postnatal	Pregnancy complicated by pre-eclampsia and control groups Primiparas	Age<18, Illiterate in Dutch Intrauterine fetal death	Pre-term pre-eclampsia Term pre-eclampsia	Clinical records	≤ 2 yrs	PSS-SR	Postal
Hoedjes et al., 2001	Netherlands	Pros. cohort	Multi. hospital (n=4)	128 (137)	50-54 [a or b]	Postnatal	Age≥18 Pregnancy complicated by pre-eclampsia speaking Dutch	--	Mild pre-eclampsia: Severe pre-eclampsia	Clinical records	6 wks 12 wks	SRIP	Postal

(cont. table 4.2)

Authors	Country	Design	Site	Size (follow-up)	Resp. Rate† %	Time of recruit-ment	Criteria		Maternal morbidity		PTSD		
							Inclusion	Exclusion	Type	Source	Time postnatal	Tool	Admini-stration
Lev-Wiesel et al. 2009	Israel	Pros. cohort	Single hospital	1071	96 [c or d]	Antenatal	Women >= 5 mths pregnant at the time of recruitment	Women under psychiatric treatment	High-risk pregnancy Delivery complications (CS, preterm delivery or fetal distress etc)	Clinical records Self-report	1 mth 6 mths	PSS-I	Interview (face-to-face/ telephone)
Sorenson & Tschetter 2010	US	Cross-sectional	Commu-nity	71	75 [c] (53 [b])	Postnatal	Listed in phone book Having 'landline' phone numbers	All others who did not meet inclusion criteria	Birth complication:	Not stated	6-7 mths	PTCS	Interview (telephone)
Stramrood et al. 2010a	Netherlands	Pros. cohort	Single hospital & single midwifery practice	175 (137)	71-91[c]	Antenatal	Women hospitalised with pre-eclampsia or PPROM	Critically ill, multiple pregnancy, A history of intrauterine fetal death, Alcohol/drug dependence Pre-existing medical conditions (diabetes, hypertension, cardiovascular, renal diseases)	Pre-eclampsia PPROM	Clinical records	6 wks 15 mths	PSS-SR	Interview
Stramrood et al. 2011	Netherlands	Cross-sectional	Multi. Hospital (n=3) Midwifery practice (n=4)	428	47 [a or b]	Postnatal	Women delivered 2 to 6 months prior to study with >=16 weeks of gestation	--	Pregnancy complications (pre-eclampsia, HELLP, antenatal blood loss or intrauterine death etc) Delivery complications (PPH, manual placenta removal or ICU etc)	Self-report	2-6 mths	TES-B	Web-based

CS=caesarean section; EICS=elective caesarean section; ICU=intensive care units; NICU=neonatal intensive care units; PPROM=preterm premature rupture of membranes; HELLP=HELLP syndrome; PPH=postpartum haemorrhage
Pros=prospective; Retro=retrospective; wks=weeks; mths=months; yrs=years; size=sample size of postnatal women; Resp. rate=response rate at postnatal period
‡ Engelhard (2002) included women's partner in their study sample, but data on women was only extracted
a) The number of all eligible women, of whom those who took part in the study.
b) The number of women who were approached, of whom questionnaire/interview were actually returned or completed.
c) The number of women who agreed to participate after the researcher approached to them, of whom questionnaires/interview were actually returned or completed.
d) Uncertain how the response rate was calculated.

4.3.3 Methodological quality

The overall quality of these studies was moderate to low when assessed for methodological quality against CASP criteria (Public Health Resource Unit England, 2006). Generalisability, a lack of clear definitions of maternal morbidity and a possibility of measurement errors of PTSD/PTSD symptoms were main issues identified from the selected studies. The methodological quality of the selected studies is summarised in table 4.3 (p.117) and discussed below. As no comparable studies were identified, and as quantitative data could not be statistically combined for a meta-analysis, extracted data were synthesised into a narrative summary. There was wide clinical heterogeneity, with different outcome measures and timing of assessment used across the included studies.

4.3.3.1 Representativeness and generalisability

Study sample sizes ranged from 71 (Sorenson and Tschetter 2010) to 1071 women (Lev-Wiesel et al. 2009). Only three studies reported power analysis (Creedy 1999; Hoedjes et al. 2011; Stramrood et al. 2010a). The power calculation cited by Creedy (1999) appeared to be performed after study recruitment, but criteria used to inform statistical significance (to inform what difference they expected to find) was not described. Stramrood et al. (2010a) calculated a sample size required to produce 80% statistical power at a significance of p=0.01. The study had two follow-up time points (6 weeks and 15 months postpartum). There were sufficient cases at the first follow-up point, but substantial loss to follow up in one of the study groups resulted in the sample size being smaller than that calculated as required for the second follow-up. Hoedjes et al. (2011) discussed the possibility of low power to detect clinically meaningful differences in PTSD and related symptoms between their study

groups (mild and severe pre-eclamptic women) due to the relatively low numbers of outcomes in their sample.

Response rates varied within and between studies (47% – 96%) as did the definition of the response rate. Some studies (e.g. Adewuya et al., 2006) defined the response rate as the number of women who entered the study from among all women who were eligible, while others defined it as the number of women who took part in the study from among those who were approached or initially agreed to participate. In the latter cases, due to the fact that women who refused were excluded from the denominators, high response rates do not necessarily indicate good representativeness of the sample. Possible bias caused by refusal was not discussed or reported in many of the studies.

Adewuya et al (2006) recruited all women eligible (postpartum women who attended postnatal and infant immunisation clinics at 6 weeks at five government health centres in Nigeria), 95% of whom participated in the study. The study did not have any pre-specified exclusion criteria, but a few women (5%) who were critically ill, spoke a different language or refused were excluded. The study clearly described the potential bias caused by non-participants who were likely to be a high-risk group resulting in possible underestimation of PTSD cases.

In a study by Lev-Wiesel et al. (2009) a convenience sample of pregnant women were recruited from one hospital in Israel. Women under psychiatric care were excluded. Of the women recruited, 96% participated in a follow up interview at one and six months postpartum.

In the studies by Hoedjes et al. (2011) and Stramrood et al. (2011) from the Netherlands, participants were recruited from several centres (hospitals and/or

midwifery practices). However, whether these sites were selected purposefully (e.g. geographical convenience) or based on pre-defined criteria was not clearly reported. Hoedjes et al. (2011) approached all eligible women (whose pregnancy was complicated by pre-eclampsia), while Stramrood et al. (2011) recruited a maximum of 200 women per hospital and 100 per midwifery practice to ensure ratios of delivery places were comparable with those in the Dutch population of childbearing women. Hoedjes et al. (2011) clearly discussed the possibility of non-response bias. Non-native Dutch women were under-represented despite ethnicity potentially contributing to PTSD.

Stramrood et al. (2010) approached pregnant women hospitalized with pre-eclampsia/HELLP syndrome [7] or preterm premature rupture of membranes (PPROM) in one university hospital. They also recruited a healthy control group with uneventful pregnancies from an independent midwifery practice. Another two studies included from the Netherlands recruited women who experienced pre-eclampsia and those who did not from one tertiary level hospital (Engelhard et al., 2002, Baecke et al., 2009). It was unclear whether all individuals who were eligible were actually approached or if they used the partial sample (e.g. convenient, matched). Engelhard et al. (2002), Baecke et al. (2009) and Stramrood et al. (2010a) excluded multiparous women from their samples.

Cohen et al. (2004) included multiple study sites in the Toronto area of Canada but site selection criteria were not clearly reported. They also excluded multiparous women, women who could not be contacted for postpartum interview and women at risk of PTSD due to poor infant outcome (e.g premature birth, multiple birth, admission to neonatal intensive care). The authors justified these exclusions saying "the mothers' experience with these infants would be highly stressful because of the

[7] HELLP stands for Hemolysis, Elevated Liver enzyme levels and a Low Platelet count.

circumstances related to the infant rather than to the experience of childbirth per se." (p.316). The authors however noted that by excluding these women, who may have been more likely to experience a difficult delivery, the extent of PTSD was probably underestimated in their study.

Ayers (1999) recruited women planning normal labour and birth (ie. not booked for elective caesarean) from one hospital in England. Creedy (1999) recruited women in their last trimester of pregnancy from four public hospital antenatal clinics, excluding those at high risk for obstetric problems. Women who had preterm birth or stillbirth were also excluded “due to the high probability of psychiatric morbidity following such event” (p.83). The findings from these studies are less likely to be generalisable to women with high medical risks because poor infant outcomes or elective caesarean section can be a consequence of a maternal complication.

A study from the USA (Sorenson & Tschetter 2010) approached women who advertised their birth announcements in a local newspaper during a specified time period (59 days), and who had listed landline phone numbers in a publicly available phone number book. Although almost all women who gave birth at this time put their birth announcements in the newspaper (99%), the proportion of women who listed phone numbers was unclear. Many of the women (47%) contacted did not agree to participate or did not return the questionnaire.

In summary, due to a lack of clarity of reporting, assessing sample representativeness was not possible in many studies. Most studies had relatively small sample sizes and/or excluded a particular sub-group of women, which could affect the generalisability of their findings.

Table 4. 3 Methodological quality of selected studies

	Adewuya et.al. 2006	Ayers 1999	Baecke et.al. 2009	Cohen et.al. 2004	Creedy 1999	Engelhard et.al. 2002
Was the cohort recruited in an acceptable way to assess the association between PTSD (symptoms) and severe maternal morbidity (SMM)? *(sample representativeness)*	Yes	Unclear - excluded women with elective caesarean section	Unclear *- recruitment process: uncertain* *- small sample†*	Unclear *- excluded women with risk of baby* *- small sample†*	Unclear *- excluded women with medical risk*	Unclear *- recruited only primiparas* *- small sample†*
Was the SMM accurately measured to minimize bias?	Unclear *hospital admission: reason uncertain* *- data source: self-report‡*	Unclear *- combined different types of complications with less severe cases‡*	Yes	Unclear *- combined different types of complications with less severe cases‡* *- data source: uncertain‡*	Unclear *- combined different types of complications with less severe cases‡* *- data source: self-report‡*	Yes
Were PTSD or PTSD symptoms accurately measured to minimize bias?	Yes	Yes	Yes	Yes	Yes	Yes
Have the authors identified all important confounding factors	Yes	Yes	No *- pre-existing psychological issues: not mentioned*	Yes	Yes	No *- pre-existing psychological issues: not mentioned*
Have they taken account of the confounding factors in the design and/or analysis?	Yes	No *- pre-existing PTSD was controlled for, but not others*	No *- numbers of pre-existing psychological issues: not controlled for*	Yes, except for controlling for pre-existing PTSD	Yes, except for controlling for pre-existing PTSD	No *- numbers of pre-existing psychological issues: not controlled for*
Was the follow up of subjects complete enough? (eg. the persons that are lost to follow-up may have different outcomes than those available for assessment)	Yes	Yes *- non-response bias clearly discussed*	Unclear *- non-response bias: not discussed‡*	Yes *- non-response bias clearly discussed*	Yes *- non-response bias clearly discussed*	Yes *- non-response bias clearly discussed*
Was the follow up of subjects long enough?	Yes	Yes	Yes	Yes	Yes	Yes
Other limitations	Cross-sectional	--	--	--	--	Retrospectively collected key variables up to previous 2 years‡

Note: ‡ There is a possibility of information bias due to misdiagnosis, recall bias or missing data (ie. refusals, non-participation, non-response). † There is a possibility of low statistical power.

(cont. table 4.3)

	Hoedjes et al. 2011	Lev-Wiesel et al. 2009	Sorenson & Tschetter 2010	Stramrood et al 2010a	Stramrood et al. 2011
Was the cohort recruited in an acceptable way to assess the association between PTSD (symptoms) and severe maternal morbidity (SMM)? ***(sample representativeness)***	Unclear *- recruited only women with pre-eclampsia* *- no healthy control* *- small sample†*	Unclear *- recruitment process: uncertain*	Unclear *- recruited women using newspaper and public phone book* *- small sample†*	Unclear *- excluded multiple pregnancy etc.* *- small sample †*	Yes
Was the SMM accurately measured to minimize bias?	Yes	Unclear *- combined different types of complications with less severe cases‡* *- data source: partially self-report‡*	Unclear *- definition, type and data source of complication: uncertain‡*	Yes	Unclear *- data source: self-report‡*
Were PTSD or PTSD symptoms accurately measured to minimize bias?	Yes	Yes	Unclear *- scale: validity not established‡*	Yes	Yes
Have the authors identified all important confounding factors	Yes	Yes	No - pre-existing psychological condition: not mentioned	Yes	Yes
Have they taken account of the confounding factors in the design and/or analysis?	No *- assessment time was controlled for, but not others*	Yes	No *- unadjusted analysis*	Yes	Yes, except for controlling for pre-existing PTSD
Was the follow up of subjects complete enough? (eg. the persons that are lost to follow-up may have different outcomes than those available for assessment)	Yes *- non-response bias clearly discussed*	Unclear *- small dropout rate, but women who did not consent at the recruitment was not reported‡*	Unclear *- non-response bias: not discussed‡*	Unclear *- women not willing to participate was not reported‡*	Unclear *- non-response bias: not assessed‡*
Was the follow up of subjects long enough?	Yes	Yes	Yes	Yes	Yes
Other limitations	--	--	Cross-sectional	--	Cross-sectional

4.3.3.2 Exposure to maternal morbidity

In four studies, the main exposure variable was pre-eclampsia (Engelhard et al., 2002, Baecke et al., 2009, Hoedjes et al 2011, Stramrood et al., 2010). Baecke et.al (2009) and Stramrood et al. (2010a) defined pre-eclampsia as "blood pressure exceeding 140/90 mmHg and proteinuria as urinary protein excretion over 300mg per 24h". The same criteria were used by Engelhard et al. (2002), but in addition, they required clinical management of pre-eclampsia for at least one week. In the study by Hoedjes et al (2011), the criteria adopted by Baecke et al. (2009) and Stramrood et al. (2010a) was used to distinguish mild from severe pre-eclampsia[8] (American College of Obstetricians and Gynecologists 2002). Baecke et al (2009) and Engelhard et al (2002) did not include a separate variable for severe pre-eclampsia, but pre-eclampsia was divided into two groups, preterm pre-eclampsia and term pre-eclampsia which were used as a proxy of severity of the condition. Engelhard et al. (2002) also used gestational age at admission to hospital, caesarean section and length of hospital stay as indicators of severity.

The exposure variable in the study by Cohen et al. (2004) was a 'difficult' birth which included maternal complications (e.g., heavy bleeding after birth, uterine infection), unplanned pregnancy, perineal trauma, long labour (12 or more hours), induced labour, assisted or caesarean birth and severe labour pain. The definition of each complication was not reported.

The remaining six studies (Ayers 1999, Adewuya et al. 2006, Creedy 1999, Sorenson & Tschetter 2010, Stramrood et al. 2011, Lev-Wiesel et al. 2009) assessed potential predictors of PTSD or PTSD symptoms following childbirth with

[8] Severe pre-eclampsia was defined as 'pre-eclampsia and at least one of the following: severe blood pressure elevation defined by systolic blood pressure ≥160 mm Hg and/or diastolic blood pressure ≥110 mm Hg, severe proteinuria (5 or more grams in 24 h), HELLP syndrome defined by a thrombocyte count≤100 × 109/l, and/or ASAT and ALAT above 30 U/l, eclamptic convulsions, or fetal growth restriction' (ACOG, 2002 in Hoedjes et al 2011, p127).

no specific exposure of interest, but included variables related to maternal morbidity. Adewuya et al. (2006) included hospital admission during pregnancy and manual removal of placenta. Reasons for hospital admission were not presented, but authors noted that “late detection of serious and life-threatening health problems in pregnancy could necessitate hospital admission” (p.287).

Ayers (1999) included data on delivery complications and the amount of blood loss but did not state if this was estimated or measured. The type of bleeding (eg. vaginal, postpartum haemorrhage) was also uncertain. Data about other obstetric events such as infant complications, mode of birth, length of labour and use of analgesia were obtained from clinical records. However, the definition of each condition in the category of delivery complication was not given. With a high proportion of women categorised as having a delivery complication (20%), it is likely that some cases might not meet the definition of severe maternal morbidity.

Creedy (1999) asked women over the telephone at 4 to 6 weeks postpartum if they experienced any maternal complications following birth (the time frame for onset was not reported). Self-reported responses included postpartum haemorrhage, medical condition (e.g. anaemia), infection (infection site not mentioned), and severe post-delivery pain. Accuracy of women’s retrospective self-report of obstetric events was checked through chart audit with a random selection of participants from one site out of four (6%, n=30) which showed the overall agreement rate was 95% (Creedy et al. 2000). Information on the item-specific accuracy was not provided. Again, considering high overall rates of self-reported maternal complications (more than 14%) among the low obstetric risk group, the majority of cases may not have been severe or life-threatening.

Stramrood et al. (2011) collected information from participants using a web-based questionnaire, on pregnancy complications (e.g. pre-eclampsia/HELLP, antenatal blood loss, intrauterine death) and labour and birth complications (e.g. postpartum haemorrhage, manual placenta removal, ICU admittance).

Lev-Wiesel et al. (2009) included high-risk pregnancy 'defined as such by their gynaecologists'. The study also collected self-reported delivery complications at approximately 1 month after childbirth that included caesarean section, preterm labour, premature delivery and fetal distress. Sorenson & Tschetter (2010) also included a variable of maternal birth complications, but the definition, type of complication and data source were not described.

In summary, apart from studies that primarily aimed to assess the effects of a specific type of maternal morbidity, the definition and type of maternal complication were often poorly described. Mild and more severe cases of maternal morbidity were likely to be combined. Moreover, obstetric procedures and maternal and fetal conditions tended to be pooled. Maternal morbidity in the selected studies does not necessarily comply with severe maternal morbidity as described earlier (NHS Quality Improvement Scotland 2010, Waterston et al 2001).

4.3.3.3 Measures of PTSD

Measures of PTSD or PTSD symptoms varied. In Adewuya et al. (2006), PTSD was assessed by a psychiatrist and a trained clinician using the MINI International Neuropsychiatric Interview (M.I.N.I) - a clinician administered, short structured diagnostic interview for DSM-IV and ICD-10 psychiatric disorders (Sheehan et al. 1998). Creedy (1999) used the PTSD Symptom Scale – Interview version (PSS-I: Foa et al., 1993), which supports structured clinical interview to facilitate the

diagnosis of PTSD. The other studies used self-report scales including the PTSD Symptom Scale – self-report (PSS-SR: Foa et al. 1993), the Davidson Trauma Scale (DTS: Davidson et al. 1997), the Self-rating Inventory for PTSD (SRIP: Hovens et al. 2002; Hovens et al. 2000), the Traumatic Event Scale-B (TES-B: Wijma et al. 1997), the Impact of Event Scale (IES: Horowitz et al. 1979) and the post-traumatic childbirth stress inventory (PTCS: Sorenson 2000). Whilst the first four PTSD scales (PSS, DTS, SRIP and TES-B) follow DSM symptom criteria, the IES has less useful PTSD diagnostic utility, as it does not measure hyper-arousal, one of three dimensions of PTSD symptoms, but does provide a good indicator of PTSD (Wilson and Keane 2004; Wohlfarth et al. 2003) and is one of the most widely used screening measures for PTSD. Most scales (PSS, DTS, SRIP, IES) showed strong validity against clinical interviews following a variety of trauma events. The TES-B has been developed for specifically for PTSD following childbirth and includes all DSM-IV criteria for PTSD. However, it has not yet been validated with clinical interviews (Stramrood et al. 2010b).

Two studies (Ayers 1999, Creedy 1999) used both the PSS (either self-report or interview version) and the IES; the PSS for estimating the incidence/prevalence of PTSD following childbirth and the IES for examining predictors of PTSD symptoms. The PSS and the IES were the most frequently used scales in the current review, but as scoring systems used in each study were different, results are not comparable. The scoring methods for DTS, PSS and SRIP adopted by Cohen et al. (2004), Engelhard et al. (2002) and Hoedjes et al (2011) respectively were also slightly modified by researchers from the original scoring methods in order to meet DSM-IV criteria. Table 4.4 provides a general description of each self-report instrument and indication of the size of measurement error and likely impact on the study results.

Table 4. 4 Summary of advantages and potential measurement errors of selected self-report instrument of PTSD symptoms

Tool	DTS	IES	PSS-SR	PTCS	SRIP	TES-B
No. of items	17	15	17	15	22	17
Response scale	5 point Likert	4 point Likert	4-point Likert	5-point Likert	4 point Likert	4 point Likert
Validity						
Sensitivity	0.69	1.00	0.62	Not yet established	0.86	Not yet established
Specificity	0.95 (cut-off of 40 on sum score)	0.78 (cut-off of 19 on sum score)	1.00		0.71 (cut-off of 52 on sub score)	
Reliability						
Internal consistency	0.99	0.78 (intrusions) 0.82 (avoidance)	0.91	0.93	0.90-0.94	0.84
Test-retest	0.86	0.89 (intrusions) 0.79 (avoidance)	0.74	Not available	0.60-0.97	--
Reporting period	Past week	Past week	Past two weeks	Not available	Past four weeks	Past four weeks
Specify stressor of interest	Yes	Yes	Yes	Not available	No	Yes
DSM-IV criteria						
A: Stressor	B, C, D	B,C	B, C, D	Not available	B, C, D	A, B, C, D, E, F
B: Intrusion/ re-experience						
C: Avoidance/numbing						
D: Hyperarousal						
E: Duration						
F: Disability						

Note: Validity and reliability were obtained from Foa et al., (1993) for the PSS-SR; Davidson et al. (1997) for the DTS; and Horowitz et al. (1979) and Wohlfarth et al (2003) for the IES and Stramrood et al (2010b) for TES-B. *The original study to test the PTCS (Sorenson, 2000) was unpublished and unobtainable.

In summary, the PSS and the DTS have high specificity (that is, the proportion of individuals classified as negative by diagnostic interview, who are correctly identified by the self-rated scale: true negative) and relatively low sensitivity (proportion of individuals classified as positives by diagnostic interview, who are correctly identified by the self-report scale: true positive). Potential measurement errors could underestimate true PTSD cases. On the other hand, the IES and the SRIP are highly sensitive and probably recognise almost all true PTSD cases (Wohlfarth et al. 2003). However, due to relatively low specificity, potential measurement errors could lead to overestimation of the true cases, although this will depend on the cut-off used to define the cases.

As Olde et.al (2006) described, the term to describe PTSD related outcomes need to be clarified because different tools measure different aspects of PTSD. From this point in the current review, the term PTSD will only be used when all diagnostic criteria of the DSM-IV-R (A: stressor; B: intrusion; C: avoidance; D: hyperarousal; E: duration and F: Disability) were met. For cases in which all symptom criteria (B, C and D) (American Psychiatric Association 2000) were met, but some other criteria (either A, E or F) were missing, the term *PTSD-profile* will be used. The term *PTSD symptom(s)* will be used when only partial symptom criteria were met or to indicate each symptom; intrusion; avoidance or hyperarousal.

4.3.4 Is there difference in prevalence and/or incidence of PTSD (profile/symptoms) between women who experienced severe maternal morbidity and those who did not?

Five studies (Baecke et al. 2009; Cohen et al. 2004; Engelhard et al. 2002; Hoedjes et al. 2011; Stramrood et al. 2010a) provided information on differences in the prevalence of PTSD profile or PTSD symptoms according to maternal morbidity status (Table 4.5, p.127).

Hoedjes et al. (2011) examined the prevalence of PTSD profile at 6 and 12 weeks postpartum among women who experienced mild (n=35) or severe pre-eclampsia (n=114). On average, the prevalence of PTSD profile (measured with the SRIP) at 6 weeks postpartum (n=128) was 9% for women who experienced either mild or severe pre-eclampsia, but the prevalence was higher for women who experienced severe pre-eclampsia (11%) than those who experienced mild pre-eclampsia (3%). At 12 weeks postpartum (n=137), the overall prevalence of PTSD profile was 5%, the prevalence for women with severe pre-eclampsia still higher (7%), compared

with women with mild pre-eclampsia (0%). Hoedjes et al (2011) also examined differences in the prevalence of each PTSD symptom (intrusion, avoidance and hyperarousal) between women with mild pre-eclampsia and severe pre-eclampsia. The prevalence of each symptom was higher for women with severe pre-eclampsia than women with mild pre-eclampsia at 6 and 12 weeks postpartum.

Engelhard et al. (2002) compared the prevalence of PTSD profile in two small groups of women who experienced preterm pre-eclampsia (n=18) and term pre-eclampsia (n=23), with two "control" groups, matched for gestational age at birth; preterm without any other complications (n=29) and uneventful term birth (n=43). Using the PSS-SR, 28% of women with preterm pre-eclampsia and women with preterm birth with no other complications met the PTSD profile. The corresponding figure for term pre-eclamptic women and women with uneventful term birth was 17% and 0% respectively. Chi-square tests showed that the difference in the prevalence was statistically significant between the four groups (p=0.004). More specifically, the stratified results by two groups according to gestational age at delivery (ie. the preterm and the term group) showed a difference in prevalence of PTSD profile between the two term groups (a higher prevalence in the term pre-eclampsia group than the uneventful term group), with no difference between two preterm groups (the same prevalence between preterm pre-eclampsia and preterm without complication), indicating that the association between pre-eclampsia and PTSD profile could vary depending on gestation of pregnancy at onset.

Similarly, Baecke et al. (2009) assessed two major PTSD symptoms (intrusion and avoidance) using the IES with different levels of exposure; preterm pre-eclampsia (n=47), term pre-eclampsia (n=18), preterm birth but no other medical complications (n=32) and uneventful pregnancy and term delivery (n=72). A cut-off of 25 in total

IES score identified that 44% of women with preterm pre-eclampsia suffered PTSD symptoms, while the prevalence was 41% for women with preterm birth but no complications, and 11% for women with both term pre-eclampsia and uneventful term delivery. The differences between the four groups were statistically significant ($p<0.001$). However, stratified results by gestational age at delivery (preterm group and the term group) showed no difference in prevalence in women with and without pre-eclampsia in the same gestational age groups.

Stramrood et al. (2010a) compared the prevalence of PTSD profile with the PSS-SR, at 6 weeks (t_1) and 15 months (t_2) postpartum in three groups; pre-eclampsia/HELLP (t_1: n=57, t_2: n=44), preterm premature rupture of membranes (PPROM) (t_1: n=53; t_2: n=31) and term uneventful pregnancy (t_1: n=65; t_2: n=62). The prevalence of PTSD profile was found to be 11% among women with pre-eclampsia/HELLP and 17% for women with PPROM at 6 weeks postpartum, which was significantly higher than following uneventful pregnancies in the control group (3%) ($p=0.04$). Stramrood et al's (2010a) sample included women whose babies died (n=12). When these women were excluded from analysis, the difference between groups (pre-eclampsia/HELLP and PPROM vs. uneventful term groups) was no longer significant at 6 weeks postpartum ($p=0.06$) indicating that the death of the baby could have a mediating role. At 15 months postpartum, 11% of women with pre-eclampsia/HELLP met the PTSD profile criteria, compared with no controls. The study noted that the low response rate in the PPROM group at 15 months postpartum did not permit any firm conclusions.

Cohen et al. (2004) examined the prevalence of PTSD profile among new mothers with a full term singleton infant, using the Davidson Trauma Scale (DTS). In a sample of 200 women, 22 experienced two or more maternal complications and 176

experienced none or one maternal complication during pregnancy and birth (e.g., heavy bleeding after birth, uterine infection, urinary tract infection, retained placenta). At 8-10 weeks following the birth, telephone interviews with the women revealed that no study participants met their predefined study criteria for PTSD-profile. The prevalence of 'high postpartum stress' was however high among women who had two more maternal complications (59.1%) compared to women who had none or one complication (29.6%). The difference was statistically significant using chi-square test (p= 0.005), but the results should be interpreted with caution because this dichotomous outcome category (high vs. low postnatal stress) was created by the authors using the DTS, which was not validated to measure PTSD symptoms (Cohen et al. 2004).

Table 4. 5 Differences in prevalence of PTSD profile/symptom (women with complication vs. women without)

Study	N*	Instrument	Time of Assessment	PTSD profile & symptoms (%)	
				Women with complication	Women without (less) complication
Baecke et.al. 2009	169	IES	6 - 18 months	PTSD symptoms 44%: Preterm pre-eclampsia 11%: Term pre-eclampsia	 41%: Preterm, no complication 11%: Term, uneventful
Cohen et.al. 2004	198	DTS	8-10 week	PTSD profile 0%: Maternal complication (2+) PTS 59%: Maternal complication (2+)	 0%: Maternal complication (0-1) 30%: Maternal complication (0-1)
Engelhard et.al. 2002	113	PSS-SR	Within 2 years	PTSD profile 28%: Preterm pre-eclampsia 17%: Term pre-eclampsia	 28%: Preterm, no complication 0%: Term, uneventful
Hoedjes et al. 2011	128 137	SRIP	6 wks 12 wks	PTSD profile 9%: severe & mild pre-eclampsia 11%: severe pre-eclampsia 3%: mild pre-eclampsia PTSD profile 5%: severe & mild pre-eclampsia 7%: severe pre-eclampsia 0%: mild pre-eclampsia	N/A
Stramrood et al 2010a	163 137	PSS-SR	6 wks 15 mths	PTSD profile 11%: Pre-eclampsia 17%: PPROM PTSD profile 11%: Pre-eclampsia 3%: PPROM	 3% Term, uneventful 0% Term, uneventful

* The number of women included in analysis

In summary, the estimated prevalence of PTSD profile and PTSD symptoms measured by self-rated scales in selected studies varied from 0% to 44% following maternal morbidity. Confidence intervals for prevalence were not provided for any of studies, but the wide range of prevalence can be explained by the small sample size in each study. The high prevalence of PTSD symptoms (11-44% at 6-18 months after childbirth) in the study by Baecke et al. (2009) may be due to the lower specificity produced by the cut-off of total IES score (total IES>25) which was selected to define the cases. However, the results of remaining studies indicated that an experience of maternal morbidity, especially of severe or preterm pre-eclampsia could have potentially increased the prevalence of PTSD profile and PTSD symptoms during postpartum period.

4.3.5 Is there a statistical relationship between severe maternal morbidity and PTSD (profile/symptoms)?

Five out of the eleven studies examined factors contributing to the presence of PTSD or PTSD profile/symptoms but treated the outcome as a dichotomous variable (eg. presence or absence of PTSD), while six studies examined contributors to the severity of PTSD symptoms by treating the outcome as a continuous variable (ie. total score of self-administered measurements for PTSD symptoms).

Hoedjes et al. (2011) conducted logistic regression analyses for each predictive variable, and showed that the PTSD profile and PTSD symptoms at 6 and 12 weeks postpartum were more frequently present among women who had severe pre-

eclampsia than women with mild pre-eclampsia. The prevalence was also higher among younger women, women who had severe pre-eclampsia, who had a caesarean birth, who had a lower gestational age at birth, a lower infant birth weight, and among women whose infant had been admitted to the neonatal intensive care unit or had died. The results were however based on analyses which did not adjust for potential confounders. Unadjusted (crude) odds ratio (OR) and statistical significance for each predictors are presented in Table 4.6.

Baecke et al. (2009) reported that preterm pre-eclamptic women had a 6.2 times higher odds of having PTSD symptoms than women who had uneventful term delivery. They had also 6.2 times higher odds of PTSD symptoms than women who had term pre-eclampsia, but with a very wide confidence interval (95% CI: 1.3-30.1). In addition, it was not clear if findings were adjusted for potential confounders as the statistical methods were not described.

Adewuya et al. (2006) conducted a stepwise regression analysis followed by bivariate analysisto identify predictors of PTSD in Nigerian women at 6 weeks postpartum. The results showed the most significant predictors of PTSD were pregnancy-related hospital admission, instrumental delivery, and emergency caesarean section (but not elective), loss of control during childbirth (as measured by the 10-item Labour Agentry Scale at 6 weeks) and manual removal of placenta.

Multivariable logistic regression conducted by Cohen et al. (2004) found that women with two or more maternal complications were more likely to have high level of postpartum stress than women with fewer complications after controlling for the effects of other variables (eg. depression during pregnancy and history of traumatic events) (adjusted OR=4.0; 95%CI=1.3-12.8). The strongest predictor of high

postpartum stress was depression during pregnancy, but with a very wide confidence interval (adjusted OR=18.9, 95%CI=5.8-62.4). A history of two or more traumatic life events, 'born in Canada' (native Canadian) and higher income had also high odds of having high postpartum stress. The latter two were unexpected findings for the authors who considered "women from developed countries may be more likely to admit to having such symptoms than women from other cultures" (p. 323).

In a sample of women who experienced pre-eclampsia (in both preterm and term pregnancies) and preterm delivery without complication, Engelhard et al. (2002) developed a three-step hierarchical multiple regression model to test the relative contribution of predictive variables that were statistically correlated with severity of PTSD symptoms in their bivariate analysis. In the first step, the gestation of pregnancy on admission was entered in the model which alone accounted for 7% of the variance in severity of PTSD symptoms. On the second step, peri-traumatic reactions (distress and dissociation) were added into the model which accounted for 43% of the variance. After adjusting for these variables, the association between PTSD symptoms and gestational age was no longer statistically significant. On the final model (the third step), individual psychological characteristics were added: peri-traumatic dissociation (β=.27, P=0.008); negative interpretations of symptoms (β=.40, P<0.001); and thought suppression (β =.25, P=0.012) which together accounted for 61% of PTSD symptoms among women participants (F=34.84, P=0.001). However, all of these psychological characteristics were "based on the subjects' recall of how they felt up to two years previously", and the possibility of recall bias cannot be discounted (Engelhard et.al 2002, p.263). Caesarean section and length of hospital stay (used as indicators of severity of pregnancy complication) were not entered in the model as these variables were not statistically

correlated with severity of PTSD symptoms (CS: r=.22, p=0.07, length of hospital stay: r=.19, p=0.12). Stramrood et al. (2010a) performed two-step hierarchical multiple regression analyses to assess factors related to the severity (sum-score) of post-traumatic stress symptoms at 6 weeks postpartum. Variables entered in the first step were history of depression (yes/no) and Beck Depression Inventory (BDI) scores during pregnancy which accounted for 29% of the variance. In the second step, variables indicative of the well-being of both mother and infant were added, that is, death of infant, hospital admission of the infant, birth weight, diagnosis of the mother (pre-eclampsia vs PPROM) and caesarean delivery which accounted for 39% of the variance. Risk factors that remained statistically significant after controlling for the effects of each variable were self-reported history of depression (β=.23, P=0.007), a high BDI score during hospitalization (β =.33, P=0.001), and infant death in the postpartum period (β=.29, P=0.001).

Similarly, a three step hierarchical multiple regression model in Stramrood et al (2011) showed significant predictors of severity of post-traumatic stress symptoms (the TES-B sum-scores) at 2 to 6 months were unplanned caesarean section (β=.11, P<0.01), high intensity of pain (β=.11, P<0.05), and low sense of coherence (β=.53, P<0.001) which explained 41% of the variance in post-traumatic stress symptoms at 2 to 6 months. Initial differences, which were found with non-parametric bivariate analysis in post-traumatic stress symptoms between women who experienced postpartum haemorrhage (>1000 ml) or pre-eclampsia/HELLP and those who did not, disappeared after controlling for the effects of each variable (e.g. mode of delivery).

Ayers (1999) examined factors associated with PTSD symptoms, intrusion and avoidance, in a cohort of women in the UK at three time points postpartum; 1 week

(n=245); 6 weeks (n=220); and 6 months (n=201). The study identified women who had severe PTSD symptoms in pregnancy (n=18, as measured with the MMPI-2-PTSD scale) and controlled for the effect during analysis. Using non-parametric statistical tests, the study found factors strongly correlated with avoidance at all three points were subjective birth experience as measured at one week postpartum (the absence of positive emotions, appraising birth as traumatic, lack of control over analgesia and different from how women wanted it to be). On the other hand, key factors correlated with intrusions over 6 months postpartum included pre-existing belief and anxiety. Interestingly, maternal complications had a negative association with PTSD symptoms - women with no labour or birth complications had statistically significantly higher symptoms of intrusion at one week after birth (Mann Whitney, $U=2619.5$, $p<0.05$) and higher symptoms of avoidance at six months postpartum than women who did (Mann Whitney, $U=2553$, $p<0.05$).

There was no statistical relationship between type of delivery (eg. emergency caesarean section), type of labour onset or complication with the baby and PTSD symptoms (intrusion or avoidance). Spearman's rank correlation coefficient also demonstrated no statistical correlation between the amount of blood loss (and either intrusion or avoidance. Blood loss, although initially correlated with women's self-appraisals of their birth as traumatic as measured at 1 week after birth using a 10 cm visual analogue response scale (Spearman's ρ .29, $p<0.001$), was not significant after controlling for negative emotions during birth, lack of positive emotion in birth and mode of delivery. The definition of blood loss was not clear (eg. postpartum vaginal or related to CS). Only the key results relevant to this study are presented in Table 4.6.

Simple regression and stepwise multiple regression analysis conducted by Creedy (1999) revealed that neither maternal delivery complications (self-reported at 4-6 weeks after giving birth) nor antenatal variables (i.e. preparedness, obstetric risk, likelihood of unexpected events, anticipatory anxiety, level of partner support, and state anxiety) were predictive of PTS symptoms (the IES total score) at 4-6 weeks among women in Australia (n=499) who had a term delivery with no serious risk of obstetric complication during pregnancy (figures not presented for maternal complication). Factors associated with PTSD symptoms were women's retrospective self-report of obstetric intervention (β=.35, P<0.001) which looked at the cumulated impact of five key variables (ie. emergency caesarean section (β=.20, P<0.0001), forceps delivery (β=.17, P<0.0001), post-delivery pain (β=.16, P<0.0001), vacuum delivery (β=.14, P<0.002) and diagnosis for the baby (β=.10, P<0.02)).

The perception of maternity care (measured at 4-6 weeks postpartum) also had a strong negative association with PTS symptoms (β=-.39, $p < 0.001$) indicating that the lower the perception of maternity care, the higher the risk of PTS symptoms. The study further developed hierarchical regression models to determine whether the relationship between obstetric intervention and PTS at 4-6 weeks postpartum was mediated by perception of care. The model identified that perception of care was not a mediator but had an additive effect on the PTSD symptoms; in other words, both obstetric intervention (β=.26, P<0.001) and perception of care (β=.32, P<0.001) directly contributed to the outcome. Creedy also examined contributors to PTSD symptoms at 3 months postpartum (n=141) among women who described a stressful birth event and had reported at least three trauma symptoms at 4-6 weeks using the IES. Multiple regression analyses showed that level of preparedness for labour and delivery (as measured in pregnancy by a 5 point Likert scale self-

assessment question 'how well prepared do you feel for childbirth?') (β=.-16, P=0.03), the perception of intrapartum care (β=.42, P=0.0001) and obstetric intervention (β=.15, P<0.05) were associated with PTSD symptoms at 3 months postpartum that accounted for 24.5% of variance. None of specific obstetric intervention (e.g. emergency caesarean section, forceps delivery) was statistically associated with PTS symptoms at this time point.

Linear regression models in the study by Lev-Wiesel et al. (2009) showed that neither delivery complications nor high risk pregnancy were statistically associated with PTSD symptoms (PSS-I total score) at 6 months after delivery among 1071 women in Israel. Instead, higher levels of subjective pain and distress during delivery assessed at 1 month after delivery (β=.51, p<0.001), depression during pregnancy (β=.15, p<0.001) and history of life traumatic events (β=.08, p<0.01) were found to be predict variables of PTSD symptoms.

Sorenson & Tschetter (2010) reported a positive correlation between maternal complications and perinatal trauma symptoms (yes/no) measured at 6-7 months postpartum using the author developed measurement (point-biserial correlation coefficient: rpbs = 0.28).

In summary, results for the relationship between severe maternal morbidity and PTSD (profile/symptoms) from selected studies were inconsistent. This could be explained by the following factors: selection bias due to a lack of definition of maternal morbidity, unreliable data sources, the sample only including relatively healthy women (e.g. term delivery), or data unadjusted for potential confounders. However, four studies (Baecke et.al 2009, Engelhard et.al 2002, Hoedjes et al. 2011, Stramrood et al 2010a) which had clear definitions of maternal morbidity and

reliable data sources tended to indicate that severe maternal morbidity could potentially increase the risk of postpartum PTSD symptoms. Of these, three studies conducted analysis only in a sample of patients with pre-eclampsia/PPROM or preterm delivery without including medically uncomplicated women (Engelhard et.al 2002, Hoedjes et al. 2011, Stramrood et al 2010). The results indicated that the association between maternal morbidly and PTSD symptoms may not be direct but possibly mediated by other factors such as distress and/or neonatal conditions (e.g. prematurity, death). However, due to the small sample size of these studies (n<180), definite conclusions cannot be drawn.

Table 4. 6 Association and effect size of maternal morbidity and other variables on PTSD (profile/symptoms)

Study	N	Method				Results (in case of ORs: risk vs. reference)		
Adewuya et al, 2006	876	Stepwise multiple regressions	M.I.N.I	PTSD	6 weeks	Admission due to pregnancy complication: yes vs. no	Adjusted OR: 11.9 †	(95%CI: 6.4–22.1)
						Mode of delivery		
						- Instrumental vs. spontaneous vaginal	Adjusted OR: 7.9 †	(95%CI: 3.9–16.2)
						- EmCS vs. spontaneous vaginal	Adjusted OR: 7.3 †	(95%CI: 3.5–15.2)
						- EICS vs. spontaneous vaginal	Adjusted OR: 2.0	(95%CI: 0.4–8.9)
						Mode of placental removal: manual vs. normal	Adjusted OR: 5.0 †	(95%CI: 2.4–10.1)
						Perceived control in childbirth: LAS < 40 vs. > 40	Adjusted OR: 5.1 †	(95%CI: 2.7–9.5)
Ayers, 1999	220	Mann Whitney Spearman's correlation Kruskal-Wallis Partial correlation (removing an effect of PTSD symptoms in pregnancy)	IES	Intrusions (sub-sum score)	6 weeks	Delivery complication: presence vs. absence	ns	
						Amount of blood loss	ns	
						Type of delivery (eg. EmCS)	ns	
						Appraising birth as traumatic	Partial correlation β=.20 ** (one tailed)	
						Different from how women wanted to be	Partial correlation β=.17*	
	201				6 months	Delivery complication: presence vs. absence	ns	
						Amount of blood loss	ns	
						Type of delivery (eg. EmCS)	ns	
						Appraising birth as traumatic	Partial correlation β=.19 ** (one tailed)	
						Different from how women wanted to be	Partial correlation β=.22**	
	220			Avoidance (sub-sum score)	6 weeks	Delivery complication: presence vs. absence	ns	
						Amount of blood loss	ns	
						Type of delivery (eg. EmCS)	ns	
						Appraising birth as traumatic	Partial correlation β=.23 ** (one tailed)	
						Different from how women wanted to be	Partial correlation β=.35***	
	201				6 months	Delivery complication: presence vs. absence	Unadjusted U=2553 *	
						Amount of blood loss	ns	
						Type of delivery (eg. EmCS)	ns	
						Appraising birth as traumatic	Partial correlation β=.24 *** (one tailed)	
						Different from how women wanted to be	Partial correlation β=.29 ***	
Baecke et.al, 2009	169	Method for ORs: not stated	IES	PTSD symptoms	6 - 18 months	Preterm pre-eclampsia vs. Term, uneventful	(Adjusted?) OR: 6.2 †	(95%CI: 2.5-15.8)
						Preterm pre-eclampsia vs. Term pre-eclampsia	(Adjusted?) OR: 6.2 †	(95%CI: 1.3-30.1)
						Preterm, no complication vs. Term, uneventful	(Adjusted?) OR: 5.5 †	(95%CI: 2.0-15.2)

(cont. table 4.6)

Study	N	Method				Results (in case of ORs: risk vs. reference)		
Cohen et al, 2004	184	Multivariable logistic regression	DTS	Postpartum stress (high/low)	8-10 weeks	Maternal complications: 2+ vs. 0-1	Adjusted OR: 4.0 †	(95%CI: 1.3-12.8)
						Depression during pregnancy: yes vs. no	Adjusted OR: 18.9 †	(95%CI: 5.8-62.4)
						History of traumatic events: 2+ vs. 0-1	Adjusted OR: 3.2 †	(95%CI: 1.2-8.3)
						Born in Canada vs. Not born in Canada	Adjusted OR: 3.2 †	(95%CI: 1.3-8.1)
						Income (Canadian $)		
						- lowest (<$32,000) vs. high (>$8000)	Adjusted OR: 0.1†	(95%CI: 0.02-0.5)
						- middle ($32,000-80,000) vs. high (>$8000)	Adjusted OR: 0.4†	(95%CI: 0.2-0.8)
Creedy et al, 1999	499	Simple regression	IES	PTSD symptom severity (sum score)	4-6 weeks	Preparedness for labour and delivery	ns	
						Maternal complications	ns	
		Stepwise multiple regressions				EmCS	Adjusted β=.20***	
						Forceps delivery	Adjusted β=.17***	
						Vacuum delivery	Adjusted β=.14**	
						Post-delivery pain	Adjusted β=.16***	
						Neonatal complications	Adjusted β=.10*	
		Hierarchical multiple regression				<u>Final model (Accounted for 21% of variance)</u>		
						Perception of maternity care (step 1)	Adjusted β=.-32***	
						Obstetric intervention (step 2)	Adjusted β=.26***	
	141	Multiple regression			3 months	<u>Final model (Accounted for 24% variance)</u>		
						Preparedness for labour and delivery	Adjusted β=.-16*	
						Obstetric intervention	Adjusted β=.15*	
						Perception of maternity care	Adjusted β=.42***	
Engelhard et.al, 2002	113	Hierarchical multiple regression	PSS-SR	PTSD symptom severity	Within 2 years	<u>Final mode (Accounted for 61% of the variance)</u>		
						Gestational age at admission (step 1)	ns	
						Peritraumatic distress (step 2)	ns	
						Peritraumatic dissociation (step 2)	Adjusted β=.27**	
						Negative interpretations (step 3)	Adjusted β=-.40*	
						Thought suppression (step 3)	Adjusted β=-.25*	

(cont. table 4.6)

Study	N	Method				Results (in case of ORs: risk vs. reference)		
Hoedjes et al, 2011	149	Logistic regression for each variable (adjusting only for assessment time – 6 and 12 weeks postpartum using GEE‡)	SRIP	PTSD profile (yes/no)	6 to12 weeks	Severity of pre-eclampsia: severe vs. mild	Unadjusted OR: 5.0*	(95%CI: 0.6–38.8)
						Mode of delivery: CS vs. vaginal	Unadjusted OR: 8.4*	(95%CI: 1.1–65.5)
						Age	Unadjusted OR: 0.6*	(95%CI: 0.4–0.7)
						Gestational age at delivery	Unadjusted OR: 0.8*	(95%CI: 0.7–1.0)
				Intrusions (yes/no)		Severity of pre-eclampsia: severe vs. mild	Unadjusted OR: 5.5 *	(95%CI: 1.6–18.7)
						Mode of delivery: CS vs. vaginal	Unadjusted OR: 4.3 *	(95%CI: 1.7–10.6)
						Admission to NICU: yes vs. no	Unadjusted OR: 5.9 *	(95%CI: 2.4–15.0)
						Perinatal death: yes vs. no	Unadjusted OR: 7.1 *	(95%CI: 1.8–27.8)
						Age	Unadjusted OR: 0.8 *	(95%CI: 0.7–0.9)
						Gestational age at delivery	Unadjusted OR: 0.9 *	(95%CI: 0.8–0.9)
						Birth weight	Unadjusted OR: 0.5 *	(95%CI: 0.3–0.8)
				Avoidance (yes/no)		Mode of delivery: CS vs. vaginal	Unadjusted OR: 3.9 *	(95%CI: 1.1–13.9)
						Admission to NICU: yes vs. no	Unadjusted OR: 4.3 *	(95%CI: 1.2–15.6)
						Age	Unadjusted OR: 0.7 *	(95%CI: 0.6–0.8)
						Gestational age at delivery	Unadjusted OR: 0.9 *	(95%CI: 0.8–0.9)
						Birth weight	Unadjusted OR: 0.4 *	(95%CI: 0.2–1.0)
				Hyperarousal (yes/no)		Severity of pre-eclampsia: severe vs. mild	Unadjusted OR: 3.0 *	(95%CI: 1.2–7.9)
						Mode of delivery: CS vs. vaginal	Unadjusted OR: 2.6 *	(95%CI: 1.2–5.7)
						Admission to NICU: yes vs. no	Unadjusted OR: 2.8 *	(95%CI: 1.3–5.8)
						Perinatal death: yes vs. no	Unadjusted OR: 6.6 *	(95%CI: 1.1–39.6)
						Age	Unadjusted OR: 0.9 *	(95%CI: 0.8–1.0)
						Gestational age at delivery	Unadjusted OR: 0.9 *	(95%CI: 0.8–1.0)
						Birth weight	Unadjusted OR: 0.6 *	(95%CI: 0.4–0.8)
Lev-Wiesel et al, 2009	1071	Linear multiple regression	PSS-I	PTSD symptoms severity (sum score)	6 months	<u>Final model (Accounted for 41% of the variance)</u>		
						Subjective pain and distress during delivery	Adjusted β=.51***	
						PTS during pregnancy	Adjusted β=.04	
						Delivery complications	Adjusted β=.04	
						Depression during pregnancy	Adjusted β=.15***	
						History of traumatic events	Adjusted β=.08**	
						High risk pregnancy	Adjusted β=.03	

(cont. table 4.6)

Study	N	Method				Results (in case of ORs: risk vs. reference)	
Sorenson & Tschetter, 2010	71	Point-biserial correlation coefficient	PTCS	Posttraumatic childbirth stress (low/high)	6–7 months	Maternal complications: yes vs. no Infant complications: yes vs. no	Unadjusted rpbs = 0.28 † Unadjusted rpbs = 0.25 †
Stramrood et al, 2010a	175	Hierarchical multiple regression	PSS-SR	PTSD symptoms severity	6 weeks	<u>Final model (Accounted for 39% of the variance)</u> A history of depression (step 1) BDI scores during pregnancy (step 1) Death of infant (step 2) Hospital admission of the infant (step 2) Birth weight (step 2) Diagnosis of the mother (PE vs PPROM) (step 2) CS (step 2)	 Adjusted β=.23** Adjusted β=.33*** Adjusted β=.29*** ns ns ns ns
Stramrood et al, 2011	428	Hierarchical multiple regression	TES-B	PTSD symptoms severity (sum score)	2 to 6 months	<u>Final model (Accounted for 41% of the variance)</u> Country of origin (step 1) Primiparity (step 1) Pre-eclampsia/HELLP syndrome (step 1) Hypertension (step 1) Preterm delivery (step 1) Secondary/tertiary care (step 2) Hospital delivery (step 2) Induction of labour (step 2) Instrumental vaginal delivery (step 2) Unplanned caesarean section (step 2) Postpartum haemorrhage (>1L) (step 2) Manual placenta removal (step 2) Perinatal death (step 2) N(I)CU admittance (infant) (step 2) ICU admittance (mother) (step 2) Fear of childbirth (high) (step 3) Delivery worse than expected (step 3) Intensity of pain (high) (step 3) Sense of Coherence (low) (step 3)	 Adjusted β=.004 Adjusted β=.06 Adjusted β=.08 Adjusted β=.04 Adjusted β=.04 Adjusted β=-.09 Adjusted β=-.05 Adjusted β=-.02 Adjusted β=-.08 Adjusted β=.11** Adjusted β=.06 Adjusted β=.04 Adjusted β=.06 Adjusted β=.05 Adjusted β=.03 Adjusted β=.02 Adjusted β=.01 Adjusted β=.11* Adjusted β=.53***

Note *p<0.05. **p<0.01, ***p<0.001, ns: none significance, † significance but the level of significance was not reported

‡ GEE: generalized estimating equation

4.3.6 Does the type of severe maternal morbidity affect the relationship between severe maternal morbidity and PTSD (profile/symptoms)?

Only five studies examined a specific maternal complication; pre-eclampsia (Engelhard et al. 2003, Baecke et al 2009, Hoedjes et al. 2011, Stramrood et al 2010a) and blood loss (Ayers 1999). As described earlier, pre-eclampsia, particularly severe pre-eclampsia and preterm pre-eclampsia increased PTSD profile or PTSD symptoms postpartum, while no correlation was found between the amount of blood loss and PTSD symptoms (Ayes 1999). In Ayers' study, the range of blood loss was not reported, and it is uncertain if there were any cases of severe obstetric haemorrhage. Postpartum haemorrhage was examined by Cohen et al (2004) and Creedy (1999), but it was clustered together with other complications (e.g. urinary tract infection, site unspecific infection). In summary, from evidence currently available, this question cannot be answered.

4.4 Discussion

This chapter contained a systematic narrative review of the association between women experiencing severe maternal morbidity during labour, at the time of giving birth or within the first week following birth, and post-traumatic stress disorder. Findings were based on a comprehensive literature search and rigorous critical appraisal of included studies.

No high quality quantitative studies were identified to determine whether women who experienced severe maternal morbidity are more likely to develop PTSD or traumatic stress symptoms than women who did not. However, the prevalence of PTSD profile among pre-eclamptic women from 6 weeks up to two years postpartum was 5%-44%. This appeared to be a higher percentage than that found

in an earlier systematic narrative review on PTSD following childbirth in general. For example, Olde et al. (2006) found that the prevalence of PTSD among women who had successful birth outcomes (including normal births and births by caesarean section, but excluding pregnancy complications) is estimated to be approximately 3% to 6% at around six weeks postpartum and decreased to around 2% at six months postpartum. Similarly, a narrative review by Ayers (2008) suggested a prevalence of 0%-7% of PTSD within one year after giving birth, while the figure was higher for at-risk groups (i.e., premature or stillbirth), up to 26% at one month postpartum. These are the estimates from different populations, but provide some idea that the rate may also be higher for women who experienced severe maternal morbidity.

An earlier systematic narrative review by Tedstone & Tarrierb (2003) on PTSD following other medical illnesses in general population (e.g., myocardial infarction, acute lung injury and stroke) suggested that the link between the severity of the illness and the development of PTSD is not always straightforward. Recent prospective studies in low-income countries (e.g. Fottrell et al. 2010) showed that the development of psychological distress following severe maternal morbidities is mediated by perinatal loss. This review also identified the possibility of an indirect relationship in which material morbidity (i.e. pre-eclampsia) influences PTSD symptoms through a third factor such as gestational age at delivery, baby's condition (e.g. prematurity, death) and negative interpretations of symptoms. However, due to the methodological limitations in selected studies, possible pathways towards PTSD or mechanisms underlying the relationship were not able to be fully explained. Insufficient evidence was available to compare the outcomes following different types of severe maternal morbidity.

Limitations of the review

This review included studies from low, medium and high income countries. However, as health care systems differ across countries, careful interpretation is required as findings from one country cannot be generalised to the others. Studies were excluded if they did not include outcomes of severe maternal morbidity. However, some conditions, such as stillbirth and caesarean section, could be a consequence of severe maternal morbidity. As these are potential mediators or contributors to PTSD (Hughes et al. 2002; Ryding et al. 1997; Turton et al. 2001), excluding them might have limited understanding of the complexities of PTSD/PTSD symptoms following severe maternal morbidity. As the current review only included studies written in English, publication bias is a possibility, as positive findings are more likely to be published in English (Egger et al. 1997).

4.5 Chapter summary

Few studies have examined the relationship between severe maternal morbidity and postnatal PTSD. Currently there is no strong and consistent evidence to support the relationship between them. However, if there is a link, it is anticipated that the cases of PTSD following childbirth would increase in the future since the incidence of severe maternal morbidity is increasing in many high income countries as discussed in Chapter 2. To understand the relationship and mechanism underlining the relationship, a well-designed prospective study is necessary which requires a large sample size; well-defined severe maternal morbidity; appropriate measurement of PTSD symptoms; and the inclusion of important factors that may influence the relationship between severe maternal morbidity and PTSD symptoms

The main aim of the research in this thesis was therefore to assess the impact of women's experiences of severe maternal morbidity on their postnatal health,

focusing primarily on PTSD symptoms. The study attempted to overcome the methodological limitations in previous studies. The next chapter will present the details of the study aim, objectives and methods used in the research.

Chapter 5

Aim and methods

5.1 Aims and objectives

The aim of the research was to assess the impact of women's experiences of severe maternal morbidity (SMM) on their postnatal health, focusing primarily on post-traumatic stress disorder (PTSD) symptoms at 6-8 weeks postpartum, when routine maternity care provision ends.

Specific objectives were to:

1. Obtain data on the prevalence of postnatal PTSD symptoms[9] and other physical and psychological outcomes among women who gave birth in one inner city maternity unit in England.
2. Assess whether there are differences in postnatal PTSD symptoms and other physical and psychological outcomes between women with and without SMM[10].
3. Examine the relationship between SMM and PTSD symptoms taking into account factors that might influence the relationship; specifically to:

    a) Examine the relationship between SMM and PTSD symptoms, adjusting for women's baseline characteristics.
    b) Examine whether the relationship between SMM and PTSD symptoms is mediated by women's perceived control during labour, poor neonatal outcomes, obstetric interventions during labour and birth, and place of birth.

[9] PTSD symptoms measured by the impact event scale (IES: Horrowitz 1986)
[10] SMM is defined as major obstetric haemorrhage, severe eclampsia/eclampsia/HELLP syndrome and IUC/HDU admission.

c) Examine the relationship between SMM and PTSD symptoms, taking into account postnatal factors (social support and other perceived stressful events in the postnatal period).

5.2 Hypotheses

The hypotheses behind the research objectives were that:

1. Women who experience SMM during labour and birth, and immediately after birth are more likely to experience PTSD symptoms and other physical and mental health problems at 6-8 weeks postpartum, compared to those without SMM.
2. There is an independent relationship between SMM and PTSD symptoms at 6-8 weeks postpartum when other factors are controlled for.
3. The association between SMM and PTSD symptoms is mediated by women's perceived control during labour and birth, neonatal outcomes, obstetric intervention and place of birth.
4. The association between SMM and PTSD symptoms is modified by postnatal factors (social support and other perceived stressful events in the postnatal period).

5.3 Study design

A prospective cohort study was undertaken. A cohort design was chosen because it is the strongest observational study design for supporting causality, as information on exposures is collected prior to the development of the outcome. Unlike cross-sectional designs, a cohort design minimises the likelihood of reverse causality, in which the outcome causes the risk factor rather than the risk factor causing the outcome (Katz 2006b). A case-control study, another commonly used observational

study design, was not suitable for this study because screening for PTSD is currently not part of routine postnatal care and therefore cases of PTSD were unlikely to be identified within the community. A case-control study would also not be appropriate to determine the prevalence or incidence of postnatal morbidity.

5.4 Ethics approval

Full ethics approval and R&D approval were obtained from the NHS Research Ethics Committee (REC 10/H0772/15) and the study site (see Appendix 5). The detail of the ethical considerations and issues that arose during the study will be discussed later in this chapter (Section 5.14)

5.5 Study variables and data sources

Three main types of variables were collected: exposure variables (SMM); outcome variables (postnatal outcomes); and other variables that might influence the relationship between exposures and outcomes, namely potential confounders, mediators and effect modifiers (the definitions of which will be described later in this section). All data on exposure were obtained from each woman's electronic clinical records held by the hospital (including maternity booking records and birth records). Information on postnatal outcomes was obtained from a follow-up questionnaire sent to women at 6 to 8 weeks after the birth. Clinical records and postal questionnaires were also used as sources for other variables. Details on data sources and definitions of each variable are listed in Appendix 6 and described below.

5.5.1 Exposure variables - SMM

After reviewing the criteria for SMM used in population-based studies in the UK (Lennox 2011; Penney et al. 2007; Waterstone et al. 2001), two types of SMM were selected: disease-based SMM and management-based SMM.

Disease-based SMM included:

- Major obstetric haemorrhage
- Severe pre-eclampsia/eclampsia/HELLP syndrome

Management-based SMM included:

- Admission to intensive care unit (ICU) or high dependency unit (HDU) after delivery (any case)

Major obstetric haemorrhage

Major obstetric haemorrhage was defined as an estimated blood loss volume greater than 1500ml (related to either vaginal or caesarean birth), or receiving a blood transfusion of four or more units in line with Waterstone et al.'s (2001) definition. Using the criteria for postpartum haemorrhage suggested by World Health Organization - i.e. 500ml (WHO, 2003), an estimated blood loss volume greater than 500ml but less than 1500ml, or one to three units of transfused blood was considered to be a minor obstetric haemorrhage.

The variable of obstetric haemorrhage was both binary (major obstetric haemorrhage: 'yes' or 'no') and categorical ('major obstetric haemorrhage', 'minor obstetric haemorrhage', 'none').

Severe pre-eclampsia/eclampsia/HELLP syndrome

Eclampsia and HELLP syndrome were confirmed if documented in clinical records. Severe pre-eclampsia was confirmed if there was evidence that a woman with pre-eclampsia[11] experienced severe hypertension (diastolic blood pressure ≥110 mmHg and/or systolic blood pressure ≥160 mmHg) (NICE 2010) and was admitted to the HDU after giving birth as a result of this.

As discussed in Chapter 2, severe pre-eclampsia is variously defined between studies and sources (guideline or primary study). The current study adopted the definition recommended by the National Institute for Health and Clinical Excellence (NICE) guideline on hypertension in pregnancy (NICE 2010), which differs from that used in Waterstone et al.'s (2001) study. While Waterstone et al. (2001) defined severe pre-eclampsia as "blood pressure 170/110 mmHg on two occasions 4 hours apart or > 170/110 mmHg once plus >0.3 g in 24 hours proteinuria or >+ + on dipstick…" (p.1090), NICE defined it as pre-eclampsia with an existence of blood pressure of "160/110 mmHg" without the criteria of "two occasions 4 hours apart". The reason for adopting the definition suggested by NICE (2010) was that, due to the lack of completeness of clinical records held by the study site, detail regarding the severity of pre-eclampsia was missing in some cases of pre-eclampsia. This meant that it was not always possible to determine from electronic clinical records the number of occasions a woman had experienced severe hypertension.

The variable related to severe cases of hypertensive disorder was both binary (severe pre-eclampsia/eclampsia/HELLP syndrome: 'yes' or 'no') and categorical

[11] New hypertension (a diastolic blood pressure of 90 mmHg or a systolic blood pressure >140mmHg) and new onset of proteinuria (as shown by 1 or more, on dipstick testing, a protein/creatinine ratio of 30mg/mmol or more on random sample or a urine protein excretion of 0.3g or more per 24 hours) at or after 20 weeks of pregnancy (Guy's and St Thomas' NHS Foundation, 2009; NCC-WCH, 2011)

('severe pre-eclampsia/eclampsia/HELLP syndrome', 'hypertension/pre-eclampsia', 'none').

HDU/ICU admission

Any cases of admission to HDU/ICU following birth were used as a proxy for SMM. The HDU at the study site is located on the obstetric unit in a tertiary referral centre and includes three beds with dedicated HDU staff. This unit is for women who require more intensive treatment and care after birth than provided on the general postnatal ward but slightly less than that provided in the ICU. If women require ventilation they are transferred to the hospital ICU, otherwise they are cared for in the HDU. This was binary variable; HDU/ICU admission 'yes' or 'no'.

All SMM cases

Women who had at least one condition of SMM as mentioned above (i.e. major obstetric haemorrhage, severe pre-eclampsia/eclampsia, HELLP syndrome, or HDU/ICU admission) were considered to have experienced SMM, while the remaining women were considered not to have experienced SMM. This fourth exposure variable was created to ensure the statistical power to detect the differences in health outcomes between women with and without severe maternal morbidity (as it was anticipated that some specific types of severe maternal morbidity - ie. severe pre-eclampsia/eclampsia/HELLP syndrome would be uncommon).

5.5.2 Primary outcome measure

PTSD Symptoms – Impact of Event Scale (IES)

The primary outcome of this study was PTSD symptoms as measured by the Impact of Event Scale (IES: Horowitz et al. 1979). Although it is critical to use clinical diagnostic interviews to establish the prevalence of diagnostic PTSD (as described in the Diagnostic and Statistical Manual of Mental Disorders fourth edition: DSM-IV), given the low prevalence of PTSD following birth, interviewing a large sample to find a few cases of PTSD would be expensive and impractical. The first step, therefore, was to screen women with sensitive questionnaires and follow up those who screened positive with clinical interviews to establish diagnostic cases (Ayers et al. 2008).

Several measures have been described in the literature to screen PTSD and its symptoms following childbirth, including the IES (Horowitz et al. 1979), the PTSD Symptom Scale (PSS: Foa et al. 1993), the Davidson Trauma Scale (DTS: Knight et al. 2011), and the Traumatic Event Scale (TES: Wijma et al. 1997). Almost all the existing self-report measures were developed for use in the general population to measure PTSD and its symptoms following a variety of traumatic events and, to date, none of the measures have been specifically validated for a postnatal population. There are a few scales purposely designed for measuring PTSD following childbirth, such as the TES (Wijma et al. 1997) and the Perinatal Post-traumatic Stress Disorder Questionnaire (DeMier et al. 1996), but these scales have not yet been validated with clinical diagnostic interviews (Ayers et al. 2008; Stramrood et al. 2010b).

Reviewing the postnatal PTSD literature, the most widely used validated scales were found to be the PSS - self report (PSS-SR) (for estimating incidence or

prevalence of PTSD symptoms) and the IES (for identifying the risk factors). Both the PSS-SR and the IES are considered highly accurate in identifying PTSD cases (Wohlfarth et al. 2003), but both scales have advantages and disadvantages. While the PSS-SR has high specificity (100%: proportion of individuals classified as negative by diagnostic interview, who are correctly identified by the self-report scale: true negative), it is disadvantaged by its low sensitivity (62%: proportion of individuals classified as positive by diagnostic interview, who are correctly identified by the self-report scale: true positive) (Essendi et al. 2011). Researchers who use a scale as a proxy of diagnostic PTSD or to estimate the prevalence/incidence of PTSD tend to prefer to use the PSS-SR.

On the other hand, the IES is highly sensitive and likely to recognise almost all true PTSD cases (Wohlfarth et al. 2003) but a drawback of the IES is that the scale does not measure hyperarousal symptoms, an important component of PTSD symptoms, and required for the diagnosis of PTSD according to DSM-IV criteria. Based on the work of Horowitz et al. (1979), Weiss and Marmar (1997) developed the Impact of Event Scale-Revised (IES-R), adding a set of items to tap the domain of hyper-arousal. However, it has been suggested that the original version of the IES developed by Horowitz et al. (1979) is psychometrically stronger in measuring post-traumatic stress during the postpartum period (Iles et al. 2011; Olde et al. 2006). Slade (2006) highlighted an issue of measuring hyperarousal following childbirth, noting, “it may be that heightened arousal is a common and potentially adaptive adjustment following the birth of a helpless and dependent infant” (p.100).

Many hyperarousal symptoms included in PTSD diagnostic criteria (e.g., difficulty of falling or staying asleep, difficulty concentrating, irritability or outbursts of anger) may be a normal reaction among postnatal women (Slade, 2006). Including

hyperarousal in PTSD diagnostic criteria therefore may overestimate the proportion of women truly affected by post-traumatic symptoms developed after an adverse obstetric event (Slade 2006). Accordingly, despite the potential drawbacks, the IES was considered to be most appropriate measure for this study.

Scoring

The IES (Horowitz et al. 1979) is a 15-item scale that measures subjective distress in response to a life event. It measures the frequency of symptoms of intrusion (seven items) and avoidance (eight items) during the past week.[12] Responses related to intrusion included “I had trouble falling asleep, because of pictures or thoughts about it that came into my mind”, and avoidance responses included “I stayed away from reminders of it”. The items were scored on a four point scale: not at all (=0), rarely (=1), sometimes (=3) or often (=5). The scores can be summed together (scores ranging from 0 to 75) or separately for each subscale’s intrusion (0 to 35) and avoidance (0 to 40). Horowitz et al. (1979) specified that scores of “20 or more” in any of the two subscales predicted a clinically significant level of distress, indicating "that diagnostic, evaluative, or treatment procedures are clearly warranted" (Horowitz 1982, p.722).

In the current study, women were asked to report how often during the previous week they experienced symptoms of distress related to an event or experience during their labour, the birth of their baby, or immediately after the birth (within 24 hours) that made them feel anxious and frightened (Appendix 12, Section 5, question 17). As suggested by Horowitz et al., 1979, if the total score was '20 or more’ in either of the two subscales, this indicated a high level of distress, while a

[12] As with many other validated self-report scales to screen PTSD, the time frame of the IES for symptom reporting does not meet the symptom duration criteria in the DSM-IV (i.e. the period of disturbance is more than one month). However, “the past week” was selected by the developers as it was "the best time unit for clinically valid reports of a person's current response level," reducing bias from forgetfulness and less conviction about intervals longer than a week (Horowitz et al. 1979, p. 210).

total score was ‘20 or more’ on both subscales this was considered to indicate a very high level of distress.

5.5.3 Secondary outcome measures

Secondary outcomes measures were depression, general health status, infant feeding and use of health services during the postpartum period. These outcomes were selected because of their potential links to severe maternal morbidity and their longer-term consequences for individual and public health.

5.5.3.1 Depression - EPDS

Earlier non-birth related trauma literature in the general population suggested that an experience of traumatic events could also lead to increase the risk of depression (Rosen and Frueh, 2010), although the link between severe maternal morbidity and depression is inconsistent across studies in postnatal population.

A number of self-report measures can be used to assess an individual’s risk of depression, including the Beck Depression Inventory (BDI: Beck et al. 1961) and the State of Anxiety and Depression (SAD: Bedford and Foulds 1978). These scales were, however, developed for use in the general population and serious limitations have been identified in their application to postpartum women (Cox et al. 1987). Some somatic items on the scales, such as weight gain, breathlessness and tachycardia, might be endorsed by women because of the physiological changes of childbearing. Sleep difficulty may also be a result of caring for a newborn baby rather than a symptom of depression. On the other hand the Edinburgh Postnatal Depression Scale (EPDS: Cox et al. 1987) was specifically developed for pregnant and postpartum women. It is a short self-report screening instrument to identify

women at the risk of postpartum depression. Acceptability of the scale to women who did not regard themselves as unwell was also an important consideration of the developers.

Scoring

The EPDS consists of ten short statements relating to enjoyment, feelings of blame, anxiety and fear, sleeping problems (due to unhappiness), sadness, crying and thoughts of harming oneself experienced in the past seven days (Appendix 12, Section 5, question 16). The EPDS includes statements such as 'I have been able to laugh and see the funny side of things' and 'I have looked forward with enjoyment to things'. Each statement is self-scored on a four point scale (0, 1, 2 and 3) by respondents and all scores summed to give an overall score (certain scores are reversed so that higher score indicates higher risk of depression). Possible total scores on the scale range from 0 to 30. Many previously published PTSD studies used a threshold of 13 and over on the total EPDS score to indicate a risk of major depression, while others used a threshold of 12 and over (Allen 1996; Cohen et al. 2004). White et al. (2006) used two thresholds; a threshold of 13 for a probable major depression and a threshold of 10 for a probable minor depression. A threshold of 13 was applied to define the risk of major depression in the current study as it was validated and would enable comparison with other postnatal studies (Cox et al. 1987; MacArthur et al. 2002; Waterstone et al. 2003).

5.5.3.2 General health - SF-12

The Short Form-12 (SF-12) was selected to measure the general health status of women after giving birth. The SF-12 is a shorter version of the Short Form-36 (SF-36) developed by the Health Insurance Experiment (HIE), a US Federal Government funded study which examined the effect of health payment systems on

the use of the health services (Ware et al. 1980). The shorter form measure (SF-12) was considered more suitable in the current study since it was used in conjunction with many other measures and there were concerns about respondent burden as well as limited resources.

The developers of SF-36 suggested that an eight subscale profile of the original 36 items (i.e. physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, energy/vitality, pain, and general health perception) could be reduced to two summary scores: a physical component score (PCS) and a mental component score (MCS) (Jenkinson et al. 1997a; Ware et al. 1996). Twelve items were selected on the basis of their relative efficiency or psychometric performance of health (SF-12). Ware et al. (1996) reported that there was a 10% loss in the ability of SF-12 to distinguish between different groups as compared to the SF-36 in the general US samples, but these differences in measurement reliability are not as important for studies with a large sample (e.g. n=500) because confidence intervals around group differences are determined largely by the sample size (Ware et al. 1996). The developers (Ware et al. 1996) have therefore suggested that "the SF-12 is able to produce the two summary scales originally developed from the SF-36 with considerable accuracy and yet with far less respondent burden" (Jenkinson et al. 1997a, p.180).

Jenkinson et al. (1997a) introduced a UK version of SF-12 and SF-36 in which minor modifications to the wording were made to make it acceptable in the UK context. They also suggested that the two summary component scores derived from the UK versions of SF-12 and SF-36 were almost identical and therefore "where two summary scores of health status are adequate then the SF-12 may be the instrument of choice" (Jenkinson et al. 1997a p.179).

Scoring

To obtain summary scores of PCS-12 and MCS-12, the manual "how to score the SF-12 physical & mental health summary scale" (Ware et al. 1995) was referred to. Firstly, the score was reversed for four items out of twelve so that higher scores indicate better health. In the next step, indicator variables (1/0) were created for the item response choice category. Indicator variables were then weighted using regression coefficients from the general population and aggregated. Aggregate PCS-12 and MCS-12 scores were standardised to norm based scoring, where the mean was set to 50 and standard deviation (SD) to 10, by adding a constant (regression intercept).

It is important to note that in the current study there was an issue related to one particular question of the SF-12, namely 'has your health limited your social activities (like visiting friends or close relatives)?' While the UK version (Jenkinson et al. 1997a; Jenkinson et al. 1997b) uses a 6-point Likert scale to answer the question (1: all of the time; 2: most of the time, 3: a good bit of the time; 4: some of the time; 5: a little of the time and 6: none of the time), the SF-12 in the US version includes a 5 -point Likert scale (with no answer option 'a good bit of the time'). Jenkinson et al. (1997b) explained that this was because "the fact that the standard UK SF-36 is based upon the original version of the questionnaire made available in the USA…. In the UK, a network of users agreed to standardise on the original questionnaire." (Jenkinson et al. 1997b). In their paper which first introduced the UK SF-12, Jenkinson et al. (1997b) noted the importance of using the scoring system with the appropriate population, and for this reason they detailed the regression weight and constant used in their research. However despite contacting the developer of the UK SF-12 (Professor Crispin Jenkinson) and the licenced company

of US SF-12 (Qualitymetric, http://www.qualitymetric.com/), an appropriate solution for weighting the additional answering option in the UK SF-12 could not be accessed. Moreover, to the best of my knowledge, this discrepancy between the UK SF-12 and the US SF-12 has not previously been referred to in any published papers (see Appendix 7 for the comparison of UK and US version of the SF-12).

After discussions with a statistician and academic supervisors to obtain the results consistent with US SF-12 for the one question where UK SF-12 used a 6-point scale, two different ways of combining the categories were tried. Firstly an answer of "3: a good bit of the time" for the UK SF-12 was combined with the answer '4: some of the time'. Secondly, an answer of "3: a good bit of the time" for the UK SF-12 was combined with '2: most of the time'. Both of these methods gave very similar results (details are described each time in the results chapters where SF-12 was analysed). As a result, the first method (combining 3 with 4) was used throughout of analyses (see Appendix 12, Section 1 for SF-12 used in the current study).

5.5.3.3 Health service use

Health service use was included as an indicator of likely postnatal health problems. Questions were adapted from validated questionnaires used in previous postnatal studies described in the Hospital to Home Postnatal care (HOP) study (Beake et al. 2010; Bick et al. 2011). In the HOP study questionnaire, postnatal women were asked to report the number of home visits they received from midwives and health visitors. Women were also asked to report if, apart from the routine postnatal check, they visited any health professional following the birth for their own health or for that of their baby. If women answered yes, they were then asked about the place of visit (GP practice, children's centre, community clinics, hospital postnatal clinic, and others) and the reason for this contact. Another question about use of health

services related to hospital readmission. Women were asked if they or their babies had to be re-admitted to hospital, and if so, how many days after the birth this happened and why.

5.5.3.4 Breastfeeding practice

As with other aspects of postnatal assessment, questions about breastfeeding practice were included because previous studies identified the potential issues of a delay in establishing breastfeeding among women who experienced SMM due to the separation from their babies as a result of ICU/HDU admission or special care required for their babies (Thompson et al. 2010). Questions were also adopted from the HOP study (Bick et al 2011, Beake et al 2010). Women were first asked if they had breastfed their babies at any time since they were born. If their answer was yes, then they were asked a question “are you still breastfeeding your baby?” Answer options were ‘no’, ‘yes, breast plus formula milk’ and ‘yes, only breast milk’.

5.5.4 Other variables - potential confounders/mediators/effect modifiers

5.5.4.1 Potential confounders - women’s baseline characteristics

Through literature reviews (Chapters 2 to 4), a number of variables related to women’s baseline characteristics (socio-demographic characteristics and pre-existing health conditions) were considered to be potential ‘confounders,’ defined as variables, which are “associated with the risk factor and causally related to the outcome” (Katz 2006b, p.6). According to Rothman and Greenland (1998), confounders may be considered as a confusion of effects in which the effect of the exposure of interest is distorted because the effects of extraneous factors are mistaken for, or mixed with, the actual exposure effect. As women’s baseline

characteristics, information on socio-demographic characteristics and pre-existing health conditions were collected.

Socio-demographic characteristics

Previous studies showed that factors associated with greater risk for severe morbidity in the UK were older maternal age, higher parity, social exclusion and non-white ethnicity (Knight et al. 2009b; Lewis 2011; Waterstone et al. 2001). Earlier postnatal and general PTSD literature from high-income countries also showed higher rates of PTSD/PTSD symptoms or distress among younger women (Lindert et al. 2009), among nulliparous women (Wijma et al. 1997), among those with lower socio-economic status, lower intelligence, or lower educational attainment (Rosen and Frueh 2010). This study therefore included maternal age (at the time of delivery), parity, ethnicity, educational qualification and the Index of Multiple Deprivation (IMD) as potential confounders.

Age

Age at the time of delivery was treated as a continuous variable, and also categorised into six age groups: '≤19', '20-24', '25-29', '30-34', '35-39' and '≥40', in line with the most recent Confidential Enquiries into Maternal Deaths report (CMACE 2011). This information was collected from the woman's clinical records.

Parity

Parity was presented as a continuous and a categorical variable. For purposes of analyses, it was categorised into: 'primiparous' for a woman who gave birth for the first time and 'multiparous' for a woman who gave birth for the second time or more. This information was collected from clinical records.

Ethnicity

Participants' self-defined ethnicity, collected from clinical records, was categorised into: 'White', 'Black', 'Asian', 'Mixed/Multiple ethnic groups' and 'other ethnic groups', as based on the Office for National Statistics (ONS) country specific ethnic group classification in England (ONS 2011b).

Educational qualifications

Women's highest educational qualifications were categorised into: 'none', 'General Certificate of Secondary Education (GCSE)', 'A-level' and 'University Degree and above' based on the UK education system. Information was collected using the postnatal questionnaires women completed at 6 – 8 weeks.

Index of Multiple Deprivation

The Index of Multiple Deprivation (IMD) was used as a proxy for an individual's socio-economic status. Women were first classified according to the area in which they lived using their postcode. A single summary score that measures the relative disadvantages of the area was produced with the combination of a number of indicators of deprivation (i.e. the proportion of the population in an area experiencing deprivation related to low income, unemployment, poor health, low education, no or low skills and training, barriers to housing and services, crime, living environment) (English Indices of Deprivation 2010). The areas were then ranked relative to one another according to their level of deprivation (ranked 1 to 5, 1 being the least deprived and 5 being the most deprived).

A limitation in using the IMD to measure socio-economic status is that it makes an underlying assumption that all individuals living in an area share the same socio-economic characteristics; this is not always the case. However, although it is

important to bear in mind such problems of 'ecological fallacy' (Piantadosi et al. 1988), recent evidence indicates that the socio-economic environment of the community where one lives confers its own risk apart from an individual standing in that community (Berkman and Kawachi 2000; Rothman et al. 2008).

Pre-existing health conditions

A number of maternal health conditions prior to pregnancy (e.g. cardiac disease, diabetes, obesity, and psychiatric illness) may impact on a woman's experiences of SMM (CMACE 2011; Kim et al. 2007; Knight 2008a; 2011; van Roosmalen and Zwart 2009a). In the current study, only obesity (measured by body mass index (BMI)) and mental health history were selected as potential confounders. These two variables were selected firstly because they are not only associated with SMM, but potentially increase the risk of psychiatric disorder (Simon et al. 2006), and secondly, because these two variables are routinely collected by antenatal staff at the study site at each woman's booking visit.

BMI

In the current study, BMI was treated as a continuous and a categorical variable. The categorisation was based on the BMI classification in the NICE guideline on obesity (National Institute for Health and Clinical Excellence 2006) as shown in Table 5.1.

Table 5. 1 Classification of Body Mass Index

BMI (kg/m^2)	NICE classification (NICE 2006a – last modified: 2010)
<18.5	Unhealthy weight
18.5-24.9	Healthy weight
25.0-29.9	Overweight
30.0-34.9	Obesity I
35.0-39.9	Obesity II
≥40.0'	Obesity III

Source: NICE (2006, p.36)

Mental health history

It is recognised that depressive symptoms during pregnancy, or having a previous history of psychiatric and psychological problems are potentially associated with PTSD and PTSD symptoms following childbirth (Ayers 2004; Bailham and Joseph 2003; Olde et al. 2006; Slade 2006). A family history of bipolar disorder may also increase a woman's risk of postpartum psychosis (CMACE 2011; Robertson et al. 2005).

In the current study, the following information was collected from each woman's maternity booking notes with respect to her mental health:

- History of schizophrenia, bipolar affective disorder or any other psychotic illness
- History of severe depression requiring treatment by a mental health service
- History of postpartum psychotic illness (for multiparous women)
- History of inpatient or outpatient treatment by a psychiatrist or mental health team
- 'Felt down, depressed or hopeless' and/or 'little interest or pleasure in doing things' during pregnancy (in the past month at the time of maternity booking)
- Family history of severe mental illness in the postnatal period or family history of bipolar affective disorder (manic depression)

For purposes of analyses a woman's mental health history was treated as a binary variable, namely 'Yes' = the woman had at least one of the above conditions or 'No' = the woman did not have any of the above conditions.

5.5.4.2 Potential mediator variables

Rothman and Greenland (1998) suggested that any factor that could be a step in the causal chain between exposure and disease should not be treated as a confounder, but should be treated as a mediator (intermediate variable). A mediator is a variable "which represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest" (Baron & Kenny 1986, p.1173).[13] Several statisticians (Katz 2006a; Rothman et al. 2008) have argued that adjusting for variables, which may act as potential mediators may also adjust away the effect of the exposure of interest, suggesting that these variables should not be adjusted for.

In the current study, women's perceived control during labour and birth, poor neonatal outcomes, medical intervention during labour and birth, and place of birth were considered as potential mediators. The rationale for this is described below.

Perceived control during labour and birth - Labour Agentry Scale (LAS)

The relationship between SMM and PTSD symptoms may be mediated by feelings of loss of control (powerlessness, fear for self and/or baby) during labour and delivery. This was considered as a potential mediator in the current study because, from the results of a synthesis of qualitative studies (Chapter 3), an experience of SMM increased feelings of loss of control, fear or helplessness which contributed to the development of PTSD symptoms.

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[13] An example of a mediator: Smoking (may cause)→ Elevated blood pressure (may cause)→ Heart disease

[Elevated blood pressure] is … a risk factor for disease (heart disease), and it is also correlation with exposure (smoking), since it can result from smoking. It is even a risk factor for disease among non-exposed individuals, since elevated blood pressure can result from causes other than smoking. Nevertheless, it cannot be considered a purely confounding factor, since the effect of smoking is mediated through the effect of blood pressure.

(Rothman and Greenland 1998, p.122)

A woman's perceived control over herself and her environment during labour and birth was measured using the Labour Agentry Scale (LAS: Hodnett and Simmons-Tropea 1987) which was administered at 6-8 weeks postpartum. The LAS has two versions, each with a different number of questions (29 questions *vs*. 10 questions). The shorter version of the LAS was used in the current study because the developer of the scale suggested that the 29-item version is unnecessarily long[14] with Cronbach's alphas being too high (0.94) (Hodnett and Simmons-Tropea 1987). Cronbach's alpha is used to measure internal consistency reliability (Nunally 1978) and if alpha is too high, it indicates "a high level of item redundancy; that is, a number of items asking the same question in slightly different ways" (Wilkinson et al. 2001, p.44). The 10-item LAS scale has high reliability (described in section 5.5.5.4) and has been widely used in studies looking at women's experiences of personal control during labour and birth (Adewuya et al. 2006; Johnston-Robledo 1998; Stremler et al. 2005) (see Appendix 12, Section 2 for the scale).

Scoring

Women were asked to rank each item on a seven-point scale from 1 = 'almost all of the time' to 7 = 'never, or almost never'. It has six positive and four negative descriptions of the perceived control experienced during childbirth. The positively worded items were reversed before a total score was obtained for analysis. The total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control.

[14] Information was provided by a personal communication with Professor Ellen Hodnett

Neonatal outcomes

An earlier review (described in Chapter 4) showed frequency of PTSD symptoms following pre-eclampsia varied according to neonatal condition, such as prematurity and death (Engelhard et al. 2002; Fottrell et al. 2010; Turton et al. 2001). Although it was difficult to decide whether neonatal outcomes were potential confounders or mediators, in the current study they were treated as mediators, in line with previous studies (Fottrell et al. 2010).

Four indicators were collected from the woman's clinical records: gestational age at birth, infant birth weight, infant Apgar score at 1 and 5 minutes and neonatal intensive care unit (NICU) admission.

Gestational age at birth

Gestational age at birth was treated as a continuous and categorical variable ('pre-term birth: <37 weeks'; 'term birth ≥37 weeks <42 weeks' and 'post-term: ≥42 weeks').

Birth weight

Birth weight was treated as a continuous (g) and ordinal variable. As an ordinal variable, birth weight was grouped into 500g bands '< 1500g', '1500 – 1999g', '2000 – 2499g', '2500 – 2999g', '3000 – 3499g', ' 3500 – 3999g', '4000 – 4499g', '4500 – 4999g', '≥5000g'.

Apgar score at one and five minutes

An Apgar score is a means of evaluating the physical condition of an infant shortly after delivery (at one and five minutes) and it includes:

- Activity and muscle tone
- Pulse (heart rate)
- Grimace response (medically known as "reflex irritability")
- Appearance (skin colouration)
- Respiration (breathing rate and effort)

Each of the five conditions above is scored on a scale of 0 to 2, having a possible total score of 0 to 10. A score of 7 or higher indicates that the baby's condition is good to excellent, while 0 to 3 is critically low requiring immediate resuscitation (Casey et al. 2001, Apgar et al. 1962). In this study, Apgar score was treated as a discrete numeric (1,2,3…10) and an ordinal categorical variable ('0-3', '4-6' and '7-10').

NICU/SBCU admission

Admission to the neonatal intensive unit (NICU) and special care baby unit (SCBU) were used as a proxy of neonatal condition. According to the level of care needed by each baby, the variable was categorised into three groups: 'NICU admission', 'SBCU admission' and 'no'.

Obstetric intervention during labour and birth

Mode of birth and manual removal of placenta have been identified as risk factors of PTSD in several studies (Adewuya et al. 2006; Ryding et al. 1997; Wijma et al. 1997). In the current study, these obstetric interventions were considered to be potential mediators, the rationale for this being that in some cases, a caesarean

section would be performed to manage severe maternal morbidity (CMACE 2011). In addition, manual removal of placenta would become necessary to prevent or manage postpartum haemorrhage. Obstetric intervention therefore cannot be simply considered as a confounder (or a risk factor of SMM), although interventions during labour, particularly caesarean section, carry significantly higher risk of life-threatening maternal complications than vaginal birth (Pallasmaa et al. 2008).

Mode of birth

Mode of birth was divided into four categories: 'spontaneous vaginal delivery (SVD)', 'breech extraction/instrumental delivery (forceps and ventouse)', 'elective caesarean section', and 'emergency caesarean section'.

Caesarean section was further classified according to urgency. Classification was based on the definition used in the study site, which is slightly different from NICE guideline on caesarean section.

1. Crash Section <20 minutes
2. Urgent Section <30 minutes
3. Emergency Section <60 minutes
4. Semi-Elective Section <24 hours
5. Elective Section (planned)

Manual removal of placenta

Manual removal of placenta may be a risk factor for PTSD symptoms, although the only evidence in support of this was based on a population in Africa (Adewuya et al. 2006) and findings may not be applicable to a population of women giving birth in England. However, as a potential mediator, the variable of manual removal of

placenta was included in the current study. A dichotomous variable described whether women did or did not have manual removal of placenta.

Place of birth

Earlier work suggested various ways in which place of birth may influence the association between SMM and postnatal outcomes. Place of birth, for example may be related to the model of care (e.g. midwifery-led and consultant-led care) which appears to influence the level of intervention and subsequent pregnancy outcome (Begley et al. 2011a; Hatem et al. 2008; Overgaard et al. 2011). However, place of birth may also be pre-determined, based on women's health status during pregnancy. Women who have health problems are normally advised to give birth in an obstetric unit (McCourt et al. 2011; NICE 2007). Women who develop complications at home or in a midwifery unit are also likely to be transferred to an obstetric unit where additional observation, treatment or medical care is available (McCourt et al. 2011).

The reason for treating place of birth as a potential mediator in the current study is because of a possible mechanism in which the presence of severe maternal morbidity might determine the place of birth, which might in turn influence women's experience and sense of safety (McCourt et al. 2011) (e.g. when complication occurs women may feel safer to give birth in the Obstetric Unit than at home due to the availability and accessibility of emergency obstetric care). Furthermore, women's experience and feeling related to the place of birth following the complication might influence the outcomes of PTSD symptoms.

In the current study, the variable 'place of birth' was divided into four categories: 'obstetric unit', 'alongside midwifery unit' and 'planned home birth' and 'birth before

arriving at the hospital (BBA)'. The first three categories were based on the definition developed by the Birthplace in England Collaborative Group (Rowe 2011) as well as the options available to women at the study site. The fourth category, BBA, was created to reflect the possibility that women had an unplanned non-hospital birth.

The obstetric unit was defined as a birth place in the hospital in which "care is provided by a team, with obstetricians taking primary professional responsibility for women at high risk of complications during labour and birth. Midwives offer care to all women in an obstetric unit, whether or not they are considered at high or low risk, and take primary responsibility for women with straightforward pregnancies during labour and birth" (Rowe, 2011, p.12). An alongside midwifery unit is located within the hospital, "offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care" (Rowe 2011, p.12). Home birth is carried out by a team of community midwives who are part of the hospital staff. BBA included birth at Accident and Emergency (A&E) department, unplanned home birth, and birth in an ambulance or public place.

5.5.4.3 Postnatal factors

Traumatic stress research in general populations has identified that social support and presence of other stressors can influence to the effect on adverse or positive outcomes following a traumatic experience (Rosen et al. 2010). The association between SMM and PTSD symptoms might be modified by postnatal social support or factors that could be causing stress in addition to an event during pregnancy and childbirth. The study therefore included these factors in analyses as potential effect modifiers. Effect modification (which is often termed 'interaction') occurs "when the impact of a risk factor on outcome is changed by the value of a third variable" (Katz

2006a, p.11). The most central difference between effect modification and confounding is that “whereas confounding is a bias that the investigator hopes to prevent or remove from the effect estimate”, effect modification is “a property of the effect under study” which the investigator wants to report in the findings (Rothman and Greenland 1998, p.254).

Social support

Ten Have et al. (2002) suggested that there are two types of social support: 1) social relationships such as living arrangements (ie. living alone) and 2) quality of relationship, expressed by individual’s perceived social support. In the current study, information on women’s living arrangements and their perceived social support as indicators of social support following birth was obtained from the 6 – 8 week postal questionnaire.

Living arrangements

Women were asked whether they lived with their partner, parents, sister or brother, any other adults or if they lived alone.

Perceived social support

Information relating to a woman’s perceived social support during the postnatal period was obtained using the Social Support Scale (SSS). The SSS was developed by the European Longitudinal Study of Pregnancy and Childhood (ELSPAC 1989) and used for the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC) cohorts and a number of postnatal health studies in the UK (Baker and Taylor 1997; O'Connor et al. 1998; O'Connor et al. 1999a; O'Connor et al. 1999b). It is a ten-item inventory that assesses whether a woman has experienced emotional support (e.g., sharing feelings, being understood) and

instrumental support (e.g., relying on others to help with tasks, financial assistance if needed). Example items include “I have no one to share my feeling with” and “my family would help with money if necessary” and each item is rated on a four-point Likert scale ranging from "this is exactly the way I feel” to “I never feel this way” (Appendix 12, Section 4 for the scale).

Scoring

Following the developers’ suggestion, the scale was scored with 0, 1, 2 and 3 on each 4-point Likert item, and then summed together to produce mean of total score.[15] The possible range of the total score would be 0-30 (two items were reversed scores). Higher scores indicated higher perceived support.

Other perceived stressful events in postnatal period

In addition to women’s birthing experiences, other perceived stress events may influence their psychological status. To understand other life stressors that could impact on women’s well-being, participants in the current study were asked to answer an additional question developed specifically for the questionnaire, “Aside from your birth, have you experienced any changes in your life within the last six weeks, which have caused you anxiety or depression?” If their answer was yes, then they were asked to report the event they had experienced.

5.5.5 Validity and reliability of self-reported scales

In this section, the validity and reliability of the self-report scales are described, based on previous literature. The reliability within the dataset in the current study is also presented.

[15] Information was provided by a personal communication with Professor Jean Golding from University of Bristol who was involved in the ALSPAC survey.

5.5.5.1 Impact of Event Scale (IES)

Reliability of the IES was tested by Horowitz et al. (1979) in a sample of patients suffering from stress response syndrome from serious life events (e.g., bereavement, injuries, violence, illness and surgery). The internal consistency of the subscales as measured using Cronbach's alpha was 0.78 for intrusion and 0.82 for avoidance. A correlation of 0.42 between the intrusion and avoidance subscale scores was sufficiently small enough to indicate that the two subsets were not identical. One-week test-retest reliability, as calculated using Cronbach's Alpha, was satisfactory with 0.89 for the intrusion subscale and 0.79 for the avoidance subscale.

More recently, validity of the IES has been tested against DSM-IV in groups of people who had experienced different forms of trauma. In a sample of crime victims, Wohlfarth et al. (2003) examined the validity against a Composite International Diagnostic Interview (CIDI: World Health Organization 1997) for the prediction of DSM-IV PTSD. The results showed a cut-off of 19 on the total IES score produced sensitivity of 100% and specificity of 78%, while with a cut-off score of 35 on the total score, it produced sensitivity of 89% and specificity of 94%. Coffey et al. (2006) selected a cut-off score of 27 for the IES total score as optimal in a sample of motor vehicle accident survivors that produced a sensitivity of 91% and a specificity of 72%, against the Clinician-Administered PTSD Scale (CAPS: Blake et al. 1995).

Current study

To date, the optimal cut-off in the postnatal population has not yet been tested. For this reason, the current study followed the cut-off of 20 on each subscale, intrusion and avoidance, following the suggestion of the developer of the scale to identify clinically significant level of PTSD symptoms. This cut-off has been used in many

other studies in postnatal population. Internal consistency reliability of the IES was assessed in the current study with Cronbach's alpha. The results showed good internal consistency of both intrusion and avoidance with Cronbach's alpha values of 0.87 and 0.86, respectively.

5.5.5.2 Edinburgh Postnatal Depression Scale (EPDS)

Previous studies

The validity of the EPDS was tested by the developers with 84 mothers at three months postpartum using the Research Diagnostic Criteria (RDC; Spitzer et al. 1978) for major depressive illness. Using a threshold of 12.5 on the total score, the sensitivity of the EPDS was 86% and specificity was 78%. The positive predictive value (the proportion of women above 12.5 on the EPDS who met RDC criteria for depression) was 73%. The EPDS demonstrated good reliability with a split-half reliability of 0.88 supporting the reliability of the scale (dividing items on the EPDS in some random manner into two halves, which were then compared; a high correlation indicated a high reliability as the items were measuring the same characteristics). With a lower cut-off of 9.5, the failed detection of cases can be reduced to less than 10% (Cox et al. 1987).

Current study

Using the results of the current study, the internal consistency of the EPDS was also good, with Cronbach's alpha being 0.86.

5.5.5.3 SF-12

Ware et al (2007) reviewed published studies to provide the evidence of the validity of SF-12. They identified various studies that tested concurrent validity in ‘known

groups' by assessing the ability of a measure to distinguish between groups differentiated by clinical definitions of diagnosis or severity in Western countries (e.g. UK, US, Spain and Australia). These results confirmed the ability of PCS-12 to generate statistically significant differences in PCS and MCS scores between one or more groups with physical and mental conditions. Physical conditions for which validity has been tested include stroke (Ware 2007) diabetes with heart disease (Benjamin et al. 2001) and lower back pain (Carmona et al. 2001). Evidence has been produced to support the MCS-12 as a valid measure of mental illnesses including depression (Andrews et al. 2001; Salyers et al. 2000), bipolar disorder (Vojta et al. 2001), anxiety (Andrews et al. 2001; Sanderson et al. 2001), substance abuse (Andrews et al. 2001; Kellinghaus et al. 2000) and personality disorders (Andrews et al. 2001). Support for the construct validity of SF-12 as a measure of physical and mental health also comes from many studies of relationships between SF-12 and other validated measures including the Nottingham Health Profile (Dunbar et al. 2001), the General Health Questionnaire (Goldney et al. 2000), and the Quality of Well-Being Scale (Andresen et al. 1999).

The validity of UK SF-12 has also been tested against UK-SF 36. Jenkinson et al. (1997) compared the UK SF-12 MCS and PCS scored with those derived from the UK SF-36, using a large-scale survey dataset (n=9332) from the Oxford Healthy Lifestyles Survey (OHLS). PCS and MCS scores gained from the SF-12 were referred to as PCS-12 and MCS-12, respectively, while those gained from the SF-36 were referred to as PCS-36 and MCS-36, respectively. The results showed a high correlation between PCS-36 and PCS-12 (0.94, $p<0.001$) and between MCS-36 and MCS-12 (0.94, $p<0.001$). The scores of two summary scales based on the SF-12 were also compared with those derived from the SF-36 for the sample divided into subgroups (genders, variety of clinical conditions etc.). The results, for example,

showed that the score for PCS-36 and PCS-12 for the female sample (n=4446) was 49.10 (SD=10.32) and 49.04 (SD=10.03), respectively, while the corresponding figure for MCS-36 and MCS-12 were 48.94 (SD=10.46) and 48.98 (SD=10.18), respectively. With this large sample in the UK, the summary scores of SF-12 and SF-36 were similar. Consequently, Jenkinson et al. (1997b) suggested that the SF-12 could produce accurate physical and mental summary scales which were almost identical to scores obtained from SF-36.

Reliability of SF-12 has been tested using internal consistency in many studies. However, the developer of the scale pointed out that internal consistency method may underestimate the reliability of the SF-12 (Ware et al. 2002). This is because the SF-12 is a multidimensional measure of health-related quality of life and each SF-12 item was selected based on the unique reliable variance in estimating physical or mental health (Gandek et al. 1998; Ware et al. 1995), while internal consistency measures the correlations between different items on the scale. Ware (2007) also suggested that "the internal consistency method of reliability is not applicable to the single item measures of the SF-12" (p.63), while SF-12 was developed using one or two items from each of the eight health concepts in the SF-36. Despite such a criticism, many studies showed good internal consistency reliability with a Cronbach's coefficient ranging from 0.80 to 0.90 across the subgroups in the general population (Ware et al. 2002).

Current study

In contrast to previous studies, the internal consistency reliability of SF-12 in the current study sample was low. Cronbach's alpha was 0.37 for physical scale summary score and 0.26 for mental scale summary score. While the use of internal consistency to estimate reliability of SF-12 may have limitations as described above,

Cronbach's alpha in the current study was much lower compared to the figures obtained in the general population. This implies that the SF-12 might not be an appropriate tool to obtain reliable information on general health status in postnatal populations.

5.5.5.4 Labour Agentry Scale (LAS)

Previous studies

Cronbach's alpha reliability coefficient for this scale has consistently been shown to be >0.88 (Lusskin et al. 2007). Factor analysis indicated LAS to be a unifactorial scale with factor loadings between 0.36 and 0.85 (Hodnett and Simmons-Tropea 1987). Concurrent validity has also been supported by field studies that showed women with spontaneous, uncomplicated births recorded the highest LAS scores (Hodnett and Simmons-Tropea 1987). Hodnett and Simmons-Tropea (1987) also tested whether the LAS scores were affected by the timing of administration of the tool. For this stability test, 60 women were selected randomly from antenatal classes in Canada and each woman assigned randomly to one of three groups. The LAS was administered to Group 1 subjects at two weeks postpartum, to Group 2 subjects at one month postpartum, and to Group 3 subjects at three months postpartum. A one-way analysis of variance showed no significant difference between LAS scores at the three time periods. The results rejected their hypothesis that "relief over having safely delivered healthy babies could influence LAS scores in the early postpartum period, while the stressors of adjustment to parenting, other contextual variables, and/or the influence of memory loss over time, could influence scores later in the postpartum period" (p.305). From these results, Hodnett and Simmons-Tropea (1987) concluded that the LAS is stable over the three postpartum time periods.

Current study

In the current study, the LAS showed good internal consistency reliability with a Cronbach's alpha of 0.82.

5.5.5.5 Social Support Scale (SSS)

Previous studies

The internal consistency (Cronbach's alpha) for the Social Support Scale was somewhat low being 0.58 (O'Connor et al. 1999b). However, the developers of the scale argued that "there was no presumed overlap among the types of support assessed or the persons providing the support" (O'Connor et al. 1999b, p.781). In a study of maternal morbidity, social support and deprivation, using the social support scale, Baker and Taylor (1997) found that "as a reaction to the lack of support from their partner with the task of caring for a new baby, women turn to other forms of support outside the home". This illustrated that different forms of support may not necessarily be linked and people may have a range of different ways of accessing support and these might operate independently of each other.

Current study

In the current study, the reliability coefficients for social support scale were high showing Cronbach's alpha=0.78.

Table 5.2 summarises the psychometric qualities of the instruments used in the present study.

Table 5. 2 Psychometric qualities of instruments used for outcome variables

	N of items	Response scale	Validity tests in previous studies	Reliability tests in previous studies	Reliability tests in the current study
IES	15	4 point Likert scale	Predictive validity Using a cut-off of 19 on sum score Sensitivity: 100%; Specificity: 78% Using a cut-off of 35 on sum score Sensitivity: 89%; Specificity: 94%	Internal consistency: α=0.78 (intrusions) α=0.82 (avoidance) Test-retest: r=0.89 (intrusions) r=0.79 (avoidance)	Internal consistency: α=0.87 (intrusions) α=0.86 (avoidance)
EPDS	10	4 point Likert scale	Predictive validity Using a cut-off of 12.5 on sum score Sensitivity: 86% Specificity: 78%	Split-half reliability: r=0.88	Internal consistency: α=0.86
SF-12	12	Dichotomous and 3-6 point Likert scale	Construct validity Concurrent validity Comparison with SF-36 - r=0.94 (PCS-12 against PCS-36) - r=0.94 (MCS-12 against MCS-36)	Internal consistency: α=0.80-0.90 (PCS-12) α=0.82-0.88 (MCS-12)	Internal consistency: α=0.37 (PCS-12) α=0.26 (MCS-12)
LAS	10	7 point Likert scale	Construct validity	Internal consistently: α>0.88	Internal consistency: α=0.82
SSS	10	4 point Likert scale	Construct validity	Internal consistently: α=0.58	Internal consistently: α=0.78

5.6 Pilot study

Prior to commencing the main study, the questionnaire was piloted on a small number of women who had recently given birth.

5.6.1 Aim & Objectives

The aim of the pilot study was to identify ways to improve the pre-designed self-administered questionnaire to be used in the main study through:

1. Assessing the feasibility of applying the questionnaire to women at 6 - 8 weeks postnatal
2. Identifying potential sources of response errors in the questionnaire
3. Modifying the questionnaire if necessary

5.6.2 Methods

The questionnaire was piloted using face-to-face cognitive interviewing techniques (Jobe and Mingay 1991; Willis 2005) on a small number of women (n=4) representing different social and ethnic groups. Because of the difficulty of gaining access to women at six to eight weeks postpartum in the community through the NHS Trust, the PCTs, and service user organisations, the participants were identified and introduced by colleagues from King's College London (family members, friends or neighbours). Although the researcher was aware of the possibility of bias caused from the recruitment procedures used for this pilot study, Willis (2005) suggested that "small scale informal cognitive interviews of friends, colleagues, and family members do appear to be effective in at least identifying problems that the designer has overlooked" (p.148). The study results were therefore considered to be valuable, indicating how the pre-designed questionnaire might be improved.

Interviews were conducted at participants' homes. Participants were asked to think-aloud when answering questions. Verbal probing was also used when participants automatically answered each question as the researcher wanted to understand how they were interpreting the questions and how they arrived at their answers. Women were also asked whether the instructions were clear or confusing and whether the questions were sensitive or not. The researcher took notes of comments regarding problems identified during testing. Each interview lasted for approximately 60 minutes.

Potential sources of error in the questionnaire were identified using a checklist from the Question Appraisal System (QAS) introduced by Willis and Lessler (1999). The QAS was originally developed to test interviewer-administered questionnaires, but many of the items apply just as well to self-administered questionnaires (Willis 2005). These items included:

- Instruction (problems with any introductions, instruction, or explanations from the respondent's point of view)
- Clarity (problems related to communicating the intent or meaning of the question to the respondent)
- Assumptions (problems with assumptions made or underlying logic)
- Knowledge/Memory (respondents are likely to not know or have trouble remembering information)
- Sensitivity/Bias (whether questions are sensitive in their nature or likely to produce social acceptable bias)
- Response categories (problems related to the adequacy of the range of responses to be recorded)
- Others (ordering, questionnaire length etc.)

5.6.3 Results and analysis

Table 5.3 shows the summary of the characteristics of the participants.

Table 5. 3 Characteristics of the participants

ID	Postnatal Week	Age (child order)	Onset of labour and mode of delivery	Special care for mother after birth (reasons)	NICU	Ethnicity	Educational level
# 1	8	26 (1st)	Spontaneous/ Vaginal	No	No	Black African	Degree
# 2	6	35 (1st)	Induced/ Vaginal	Yes (high fever/ hypertension)	No	Asian	Degree
# 3	5	26 (2nd)	Spontaneous/ Vaginal	No	No	Black African	Degree
# 4	4	17 (1st)	Spontaneous/ Emergency CS	Yes (CS/ hypertension)	Yes	White British	GCSE

5.6.3.1 Feasibility of administering the questionnaire at 6-8 weeks postnatal

Three participants cradled their baby in their arms while they were answering the questionnaires with only one hand being available to write the answers. Participant concentration was often interrupted when their babies were crying. One participant thought the questionnaire was too long, but all considered that completion was manageable as the questions were simple to answer.

5.6.3.2 Potential source of response errors in the questionnaire

Table 5.4 describes the details of the responses to the questions, potential problems that were identified and amendments that were made after testing the questionnaire.

5.6.4 Conclusion

Feasibility of applying the questionnaire and potential sources of response errors in the questionnaire were assessed systematically. As a result, minor modifications were necessary for the final questionnaire.

Table 5. 4 Potential problems and amendments

Section	Original questions	Participants' answer	Potential problems	Amendments
1. General health (SF12)	Q1. In general, would you say your health is 1) Excellent 2) Very good 3) Good 4) Fair 5) Poor	One participant answered the question, considering her current health status. *Excellent...I don't have any health problem now (#1)* Another answered the question, considering her health from her childhood to up to now: *Excellent. I am healthy up to now...(Researcher: what do you mean up to now?) Well...after birth... during pregnancy...in my childhood (#3)* One participant who had a caesarean section (CS) considered her health as 'good' which she would have rated for her health before CS too. She perceived that her health problems after CS are within the 'normal' process of recovery. *The first two weeks [after CS] was very tricky. I'm still not back to normal...That's normal because I had CS. (#4)* One participant ticked two boxes (i.e. excellent and good) requiring further information to answer the question *Are you asking me how I perceive my health before I gave birth or after? My answer depends. My health condition was excellent until I was told I got high blood pressure after giving birth. I've been getting better…so… 'good'? (#2)*	**Clarity:** This question is to understand people's general health perceptions (Ware and Sherbourne 1992). People's concept of 'health in general' however varied because the reference period was not well specified in this question. There seemed no problem if women's perceived health status was the same before and after birth. However, an issue arose when women experienced a dramatic change in their perception of their health before and after birth. In such a case, some women might answer their relative health status, comparing their current health status to their health before birth or immediate after birth. In other cases, women might think about their health before birth, considering their current health issues being temporal.	Q1. In general, would you say your *current* health is

Section	Original questions	Participants' answer	Potential problems	Amendments
	Q2. The following questions are about activities you might do during a typical day. Does your health limit you in these activities? 1) Moderate activities, such as moving a table, pushing a vacuum 2 Climbing several flights of stairs	One participant ticked two boxes: *Again, my answer depends on the meaning of the question. Is it before or after giving birth (#2)* One participant (#3) thought that the question was asking for information over the long-term period (before and after birth), while another (#4) answered her current situation within the last few days.	**Clarity:** People's interpretation of the question varied because the reference period was not specified.	Q2. The following questions are about activities you might do during a typical day. Does your *current* health limit you in these activities?
	Q3. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health</u>? a) Accomplished less than you would like b) Were limited in the kind of work or other activities	Participant #4 (4 weeks after CS) answered 'No'. (Researcher: how did you come up with that answer?) *Well...the first four weeks is a healing period after CS. You won't expect much (#4)* Participate #2 also answered 'No', saying *I was not able to move after birth, but I didn't feel I was limited in some activities because I didn't try to do something…* Participant #1 said *I am not working. I am on maternity leave.*	**Assumption/bias:** The researcher assumed that the patients after CS and clinical health problems have some kind of limitations of their activities within 4 weeks after birth. The researcher therefore thought the answer 'no' was given by mistake (or misreading of the time period), but it was not the case. **Assumption**: "Work" is considered as the place of employments which seems not relevant to be asked for the majority of women at 6-8 weeks after birth	Q3. During the past 4 weeks, have you had any of the following problems with your ~~*work or other*~~ regular daily activities <u>as a result of your physical health</u>? b) Were limited in the kind of ~~*work or other*~~ activities
	Q4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u>? a) Accomplished less than you would like b) Didn't do work or other activities as carefully as usual	Participant #1 said *Again, I am not working.*		Q4. During the past 4 weeks, have you had any of the following problems with your ~~*work or other*~~ regular daily activities <u>as a result of any emotional problems</u>? d) Didn't do ~~*work or other*~~ *regular daily* activities as carefully as usual

Section	Original questions	Participants' answer	Potential problems	Amendments
2. Perceived control during labour and birth	No amendment required			
3. Postnatal care	Q8. Have you had any visits from midwives at your home? 0, 1…6 or more	Participant #1 answered *Yes, once. Health visitor also came. I got a routine health check-up. My sister visited me. She is a qualified midwife but she came as a sister, not as a professional midwife (#1).* One participants #*4* asked: *Health visitors came. Do you want me to include this here? I suggest you to separate midwives from health visitors*	**Clarity:** The researcher had expected to observe the problem given that participant may have difficulty to define 'midwives' if they had a midwife in their family members or friends. On the contrary, the term was well understood. **Category:** The participant pointed out eligible response is missing which is 'visits from health visitors'.	Q8. How many visits from midwives and health visitors did you have for postnatal care at your home? Midwives 0, 1…6 or more Health visitors 0, 1…6 or more
	Q10. Following the birth of your baby, did you seek care from any health professionals at a place <u>other than your home…</u>? If yes, Where? Reason for visit? When?	One participant answered 'yes' as she visited GP for her routine postnatal check, but she was not sure of the date she visited GP *I visited the GP for my 6 week postnatal check. When? ...can't remember... it was the last Tuesday. What was the date? Do we need the date? Let's say 23rd (#1).*	**Clarity**/c**ategory:** This is the question to understand if women who experienced severe maternal morbidly is more likely to use health care service. Therefore it should be separated from routine postnatal check. **Memory:** The participant was struggling to recall the information asked for. As a result, the answer given appeared to be an estimate.	Q10. *Apart from the 6 week postnatal check,* did you seek care from any health professionals at a place other than your home…? Remove the date.
4. Social support (SSS) and other perceived stressful events during postnatal period	Q14-10 If all else fails I know the state will support and assist me.	One participant asked: *State? What does "state" mean? The UK government?(#1).* Researcher asked other participants: What does the term "state" mean to you in this question? All answered 'Government'. However, one participant pointed out: *It's not clear. What sort of support? Financial? (#2)*	**Clarity:** The term "the state" was vague. The participants tended to interpreted states to "government".	If all else fails I know *heath and social services* will support and assist me.

Section	Original questions	Participants' answer	Potential problems	Amendments
	Q15. Have you experienced any changes in your life within the last 6 weeks, which has caused you anxiety or worry? If Yes, Could you please say what?	One participant answered 'Yes' but left the question, "could you please say what?", blank. (Researcher: Is there any reason for leaving here blank?") *Oh yes. My answer was definitely 'yes'...but there was no specific event. What I am worried about is something ambiguous... I started to worry, for the first time in my life, about getting old and getting weak...my strength has gone after birth. My baby is still small and needs my care... My attitude toward my husband has changed. I hate arguing with him… but we always start arguments…we have different opinions how to bring up our daughter. (#2)*	**Clarity:** It is difficult from this question to distinguish between worry/anxiety after birth and other stressful life events (loss of loved one, financial crisis). Although both pieces of information are important they need to be distinguished from each other because worry/anxiety after birth itself can be a postnatal outcome, while other life stresses can be an exposure or confounder for poor postnatal outcomes.	Q.15 Aside from your birth, have you experienced any other changes or stress in your life within the last 6 weeks, which has caused you anxiety or depressed (e.g. loss of loved one, redundancy)? If Yes, Could you please say what?
5. Depression (EPDS)	No amendment required			

Section	Original questions	Participants' answer	Potential problems	Amendments
6. PTSD symptoms (IES)	Q17 – introduction. Occasionally a woman who has had a baby may find it difficult to forget a particular event or experience that happened to her when she gave birth which may have made her feel anxious or frightened. Below is a list of statements which we would like you to consider with respect to <u>giving birth</u> to your baby…	Participant #2 gave her comment on the section as a whole: *I found this section was difficult to answer...I don't have much feelings of giving birth... It seems my emotions are not attached to me when I talk about my birth experience...but I can't say my birth experience was traumatic... My life with my baby is wonderful. I try to think everything was necessary to have my new life.* (The researcher asked, if I add one sentence like this: "by saying *it*, we mean an event during labour and birth which made you anxious and frightened", will you change your answer?") *Yes. I think about the balloon at my induction, rather than my birth experience in general. It was very painful... It took three days to start my labour. I was very scared and frightened to have a strong pain.* Participant #4 also had a problem with this question: *This section doesn't make sense to me. I had CS. During labour you have drugs...for example, gas air, epidural. That makes you sleepy... forgetful. You can't remember much how you felt...or... painful or stressful when you are giving birth (#4)* (The researcher asked, if I add one sentence like this: "by saying it, we mean an event during labour and birth which made you anxious and frightened", will you change your answer?") *Yes. Before CS, I suffered a lot of pain... more than 40 hours. (#4)*	**Instruction/clarity/bias:** Women have mixed emotions during birth. Paying attention only to an event which made them anxious and frightened seemed to make it easier to answer this section, because women did not need to reject their birth experiences which were related, for the majority of women, to their valued life with their new born babies. In addition, the term "giving birth" appeared to be problematic for some women as it could be seen as a narrow concept, which was only the time when a baby comes out of its mother's body, rather than the whole process of labour and birth. The time frame, during which stressful event could occur, need to be more specified.	Q17 – introduction ~~Occasionally a woman who has had a baby may find it difficult to forget a particular event or experience that happened to her when she gave birth which may have made her feel anxious or frightened.~~ Below is a list of statements which we would like you to consider with respect to <u>giving birth</u> to your baby… Added a sentence, *"by 'it', we mean an event or experience during your labour, or birth of your baby, or immediately after the birth (within 24 hours) that made you feel anxious and frightened".*

Section	Original questions	Participants' answer	Potential problems	Amendments
	Q16-1. I thought about it when I didn't mean to	Participant #1 said: *About what?* (Researcher asked her to read the underlining sentence which says "with respect to give birth") *OK... I didn't read it ...it's a bit long, isn't it?* Participate #3 answered the question with positive feeling. *Yes. Often. I was so excited when I saw my daughter for the first time.*	**Clarity/ bias:** Instruction was skipped because the participant thought the instruction was too long. The word "it" was not clear that could be interpreted as either negative or positive things.	Amendments are made in Instruction
	Q16-3. I tried to remove it from my memory	Participant #1 changed her answer: *Yes, sometimes.* *(after a period of silence)* *No... not at all. It was painful though, it was normal thing. My baby was safe. So, my answer is "not at all".*	**Clarity/ bias:** The word "it" could be interpreted variably. First, the participant interpreted "it" to mean "pain" which she sometimes tried to remove from her memory. Then, she interpreted "it" to the outcome of her birth that was "her baby was safe" which she never wanted to remove from her memory.	Amendments are made in Instruction
	Q16-10. Pictures about it popped into my mind	One British participant #4 said: *Not at all. No one took a picture of me. You know, taking a picture is a sort of luxurious thing.*	**Clarity:** "Pictures about it" was interpreted as photographs of her birth rather than a thought or memory in her mind.	Q16-10 Pictures *(thoughts)* about it popped into my mind
6. Others	Q.18 Could you please tell us if you live with any other adults? 1) None 2) Husband/partner 3) Parents/sisters/brothers 4) Other	Two participants were at their parents' home when they answered the questionnaires and therefore didn't tick the box 'husband/partner'.	**Clarity:** From this question, it is not clear whether women are single mothers or not. However, it is also important to know about adults who can support women during postnatal period.	Amendments are not necessary
7. Overall		Three of four participants skipped one or two questions by accident. Skipped questions were: S-12 (one participant) IES (two participants)		The questionnaire was re-designed to minimise errors (e.g. skipping) by making a space and changing the colour between lines.

5.7 Sample size calculation

The primary study outcome was the prevalence of PTSD symptoms at 6 – 8 weeks after birth, using the IES as a proxy measure. As PTSD is a relatively rare event, a sufficiently large sample size was required. The sample size for the current study was based on the findings of Czarnocka and Slade (2000) and Engelhard et al. (2002) who estimated the prevalence of PTSD symptoms in the postnatal population. Czarnocka and Slade (2000) showed that approximately 2% of women in England had PTSD symptoms using the IES at six weeks. Czarnocka and Slade's (2000) study was used to estimate the prevalence of PTSD symptoms in women who had relatively healthy pregnancy outcomes because their sample size was the biggest in the UK at the time of starting of the current study (n=264). The only other UK studies with a similar sample size had a slightly higher proportion of cases with PTSD symptoms (Ayers et al. 2007), but the Czarnocka and Slade study was chosen as the basis for the calculation as it was considered important to include the possibility that the proportion of women with PTSD symptoms in the current study being as small as theirs.

Estimating the proportion of PTSD symptoms among women who have experienced severe maternal morbidity was difficult given the dearth of evidence. A Dutch study by Engelhard et al. (2002) found that 28% of women had PTSD symptoms (measured by the IES) following childbirth complicated by severe pre-eclampsia. The percentage appeared to be very high, but this was the only evidence available at the time of starting the current study.

The estimation of the incidence of SMM was based on the study by Waterstone et al (2001), which found that 1.2% of women experienced SMM in the South East Thames region. Waterstone et al.'s finding was used as the current study was

conducted in the same geographical region. The required sample size to detect this difference at a 5% level of significance with 80% power in the current study was 1585. Allowing for a 50% loss to follow-up after excluding ineligible women, a total of 3170 women needed to be invited to take part in the study. However, the prevalence of PTSD symptoms following SMM was unknown in the UK, thus the current study recruited a slightly higher number of women (about 3500) to ensure study power. The sample size calculation was undertaken using STATA and reviewed by a statistician based at King's College London.

5.8 Setting and research site

The study site was an inner city NHS Trust in England. The site was purposely selected because it is one of the biggest maternity units in England serving a diverse population.

5.9 Recruitment

Women who gave birth under the care of this NHS Trust between 7th June and 21 December 2010 were invited to participate. Recruitment took place at four places: the postnatal ward, the obstetric unit, the alongside midwifery unit and women's homes for those who had home birth. Eligible women (as mentioned below) were approached by midwives who offered them a research information package that contained an invitation letter with the tear-off slip opt-out sheet (Appendix 8) and an information leaflet (Appendix 9) before they were discharged from the hospital after giving birth (usually within 24 hours after birth for women without complications and a few days after for women with caesarean section or special care). To ensure all eligible women were invited to the study regardless of their experience of SMM, the researcher who was blinded to women's experience of SMM also visited the

maternity units 4 to 6 days a week to provide the information package to women. Women who gave birth at home were provided with the research information package by community midwives when they attended the birth.

Women who did not wish to take part in this study could opt-out by calling a designated telephone number, sending an e-mail to the researcher or by returning the tear-off slip opt-out sheet using an enclosed freepost envelope within the following three week period.

5.10 Inclusion and exclusion criteria

The inclusion criterion for this study was women who gave birth after 24 weeks gestation. Exclusion criteria were women under 16 years old and those who were unable to read or understand English. The study also excluded women who had a stillbirth or neonatal death.

Amendment of exclusion criteria and recruitment procedure during the study

The original intention was to include women who suffered a stillbirth or neonatal death because these women were thought to be more vulnerable to psychological problems including PTSD symptoms. It was also considered important that women who had experienced loss had an opportunity to have their voices heard. In the Participants Information Leaflet, the potential risk of the participation in the study was clearly made in the following statement: “Answering the questionnaire may cause unexpected distress because we will ask you, in the postal questionnaire, to recall your birth experience and health care services you received during and after birth. You may find these questions insensitive, particularly if you had experienced an extremely distressing birth such as losing your baby”. All women were provided

with an opt-out letter before they left hospital, which they were asked to return to the researcher if they did not wish to take part in the study.

During the first two months of recruitment, two women who had experienced a stillbirth unfortunately did not return an opt-out letter and contacted the researcher expressing concern that they had received a copy of the postnatal questionnaire. To prevent further distress to these women, the researcher discussed the issue with academic supervisors and the Director of Midwifery at the study site. The study team decided to exclude women who had stillbirth or neonatal death given concerns about the distress being asked to participate in the study. The amendment was approved by the ethics committee (Appendix 5).

5.11 Data collection process

5.11.1 Postnatal questionnaire

After identifying women who did not wish to take part in the study, the IT manager at the study site provided the researcher with the necessary information to send the questionnaires weekly. Information included names and addresses of women who gave birth during the recruitment period, their patient ID, date of birth of their babies, age at delivery and if a translator had been used for maternity care. Requirement for translation during birth was used as a proxy measure of language ability. Information on women who had a stillbirth or neonatal death was added later after the ethics amendment was approved for excluding these women.

The pack was mailed to eligible women six weeks after giving birth. The pack contained a covering letter (Appendix 10), consent form (Appendix 11), a research information sheet (Appendix 9), a copy of the questionnaire (Appendix 12), and

freepost return envelopes. A reminder was sent two weeks after the first mailing in which a replacement questionnaire and a new letter were included (Appendix 13). To increase the credibility of the study, logos of the researcher's host university and the research site hospital were printed on the questionnaire and envelopes. All participants on the database were assigned a numerical code so that it was possible to track women who did not respond. Questionnaires were posted between 14 July 2010 and 11 February 2011.

5.11.2 Efforts to increase the response rate

A number of efforts were made to increase the response rate (Edwards et al. 2002; McColl et al. 2001). These included a reminder, personalised cover letters with a handwritten signature of the researcher, colour printed questionnaires to increase attractiveness and inclusion of a pen to answer the questionnaire. Two types of posters were also created to advertise the research, one for women (Appendix 14) and another for midwives (Appendix 15). The posters for women were placed in various places (e.g. on the back of the toilet door in each room in the obstetric unit and the alongside midwifery unit, and in common rooms, such as for breastfeeding and corridors in the postnatal wards). The posters for midwives were put on the walls and desks in the staff rooms. A letter that explained the importance of the study was also distributed to clinical and community midwives to create a supportive environment for this study (Appendix 16).

5.12 Dataset creation

5.12.1 Data entry and cleaning: Postnatal questionnaire

To minimise data entry errors from postal questionnaires into the database, an experienced company, Market Research Group (MRG;

http:/www.themarketresearchgroup.co.uk) was used. Manual data entry was undertaken by trained staff into an individually designed database format using Snap, a software package which allowed the questionnaire to be fully coded at the data entry stage, to reduce possible coding errors. A forced response was set up in the database format to ensure no data would be omitted. Data quality was checked at two levels by MRG: once at the data entry level by a quality control supervisor who checked for format, inconsistencies and extreme outliers, and then re-entered 10% of cases to compare the levels of accuracy; and another by the data manager for overall quality. The dataset was given to the researcher in the form of an SPSS file.

The accuracy of data entry was double-checked by the researcher after consultation with a senior data manager and academic supervisors at King's College London. First, the occurrences of duplicated, missing and misread study IDs were carefully checked using an SPSS frequency table and manually checked by comparing study IDs entered in the SPSS files and those that existed on the original questionnaires. Other data (e.g., date of completion of the questionnaire, SF-12, postnatal care) were checked when necessary for the identification of the correct study IDs. Although the process was tedious, it was crucial for this study because there were a number of separate tables that needed to be combined to create the final dataset for analysis; the study ID was used for this purpose, together with the clinical patient IDs. The next stage of ensuring data quality was to check each entry in the SPSS file for 10% (i.e. 180) of randomly selected questionnaires. Two people (the researcher and a colleague) were involved in this process; one read the results of the original questionnaire and another checked the data entered in the SPSS file. Finally, frequencies of each variable, table and graph were reviewed in order to highlight inconsistencies and outliers. These processes identified that data entry

errors occurred in just under half of questionnaires, raising concern that these data errors would skew study outcome findings (Appendix 17).

As a result, the entire dataset was completely re-entered by two, fully-trained members of staff in MGR (neither of whom had entered data the first time). The quality of the second data set was ensured by MGR who explained:

> "Due to previous issues, the accuracy of the data entry was checked in three stages: a brief check by the data entry staff to check for any obvious inconsistencies, a check of 70% of cases by two quality control supervisors analysing format, further inconsistencies and extreme outliers and a final 20% check. At each of these stages, corrections were made if necessary." (Appendix 18 - a letter from MRG).

The accuracy of data entry was again double-checked by the researcher with the same process used for the first dataset except for checking 10% of questionnaires. Special attention was made to the data quality of the primary outcome of interest, the IES, by checking inconsistency between the first dataset and the second dataset. No errors were found in the new dataset. However, it was discovered that, in some areas of missing answers, that women had put notes indicating their answers, instead of ticking the answering boxes. In such cases, missing answers were filled in by the researcher.

5.12.2 Data entry and cleaning: Clinical data

Information on baseline characteristics and pregnancy outcomes of all eligible women from clinical records were provided by the IT manager and a Consultant Midwife/Clinical Trial Manager in Maternal and Fetal Research Unit in the study site (datasets did not contained personal identifiable information except for patient ID). A senior data manager at the study site then combined data from clinical records with

data from the postnatal questionnaire. Following this, the patient IDs of women who did not participate in this study or did not provide consent for the researcher to access their clinical records were deleted so that no identifiable information remained in the dataset. This dataset was used for the comparison of women's baseline characteristics between participants and non-participants. The senior data manager also created a separate dataset that only contained data from study participants who gave consent for the researcher to gain access to their clinical records. This second dataset was used throughout the analysis.

To improve the quality of the dataset, the Field Worker Access[16] was obtained under the supervision of a Director of Midwives at the study site. This enabled access to women's clinical records to check for some areas of missing data, which were then filled in where possible. In order to have reliable data on SMM, a clinical midwife and a HDU member of staff double-checked the HDU admission records for the cases of eclampsia and HELLP syndrome that occurred during the study period (all women with eclampsia and HELPP syndrome should have been admitted to the HDU according to a hospital guideline for management of eclampsia and HELLP syndrome). The clinical midwife then checked whether women identified from the HDU admission record participated in this study by matching the patient IDs listed in the dataset. In addition, women who received blood transfusion (one of indicators of major obstetric haemorrhage) were crosschecked with the Blood Transfusion Record with the assistance of a Senior Biomedical Scientist at the study site. Details on the quality check and missing data in each variable are described in Appendix 19.

[16] FWA allows staff to access the Trust network from home via a secure token.

5.13 Dealing with missing data

Despite efforts to minimise missing data, this was an issue at every stage of data collection. The opt-out procedure initiated at the initial stage or follow-up period meant that the study had incomplete data for some cases (the questionnaire did not arrive by post or was not returned); these cases were excluded from analysis. Those who returned a questionnaire without giving consent to access clinical records were also excluded from analysis, being treated as non-participants.

Of the study participants (those who returned questionnaires and agreed that the researcher be given access to their clinical records), missing data occurred for a number of study variables. Reasons included non-completion of some of the questions in the six-week follow-up questionnaire, non-completion of clinical coding by hospital staff or information not available, for example no pregnancy information due to women not attending antenatal clinics. The degree to which missing data becomes problematic depends on the pattern and amount of missing values (Kim and Bentler 2002; Little and Rubin 2002). With advice from a statistician, pairwise deletion, also known as available case analysis,[17] was performed for missing data. Non-imputation was justified as the study sample was large and there were comparatively few missing cases for important variables.

5.14 Ethical considerations

5.14.1 Women with symptoms of mental health problems

All information, including the study leaflet and questionnaire, advised women to contact their GP, midwife or health visitor if they had any concerns about their health. Women who returned a completed questionnaire, indicating probable

[17] Pairwise deletion uses all the cases that are available and only individual missing values are deleted

existence of PTSD or other psychiatric disorders were contacted by phone and asked if they had particular concerns and if they had spoken to a healthcare professional about their concerns. A protocol was developed with advice of academic supervisors and the Director of Midwives at the study site to determine when and how women should be contacted if they had signs or symptoms of mental health problems (i.e. EPDS≥13 or IES score≥20 on both subscales) (Appendix 20). A total of 207 women were contacted by telephone, of which around 20% of women could not be reached, even after five attempts made at different times and on different days. In such cases, a letter was sent to advise them to contact their GP or health visitors.

5.14.2 Risks/Burden

Completing the IES, which was used to assess PTSD symptoms, involved in focusing attention on events or experiences during birth that made women feel anxious or frightened. This would possibly exacerbate distress (Wilson and Kean 2004). The information sheet explained any potential risks, which may occur from taking part in this study, and listed local psychological support services available to women. The information leaflet also provided contact details of the Head of School in the University where the research was based on and the Patient Advice and Liaison Service at the study site if women wished to complain about any aspect of the research. No women contacted these places to complain about the study, but two women who experienced stillbirth contacted to the researcher directly expressing their distress at receiving questionnaire as described earlier (Section 5.10).

5.14.3 Voluntary participation

All potential participants were informed that they could exercise the right of voluntary participation by opting-out, by not completing, not responding or not returning the study questionnaire (the number of each case will be described in Chapter 6, Section 6.1). Women were able to withdraw from the study at any time, without giving a reason. They were guaranteed that their subsequent care would not be affected.

5.14.4 Confidentiality

Potential participants were assured that any information they provided would be treated in the strictest confidence and not be used for any purpose except for this study. Women were also reassured that any reports or publications arising from the study would not contain any names or identifiable information. Questionnaires were answered anonymously but each woman had a unique identification code to ease data management and analysis.

5.14.5 Limits to confidentiality

The only limit to the confidentiality of the information provided by study participants was described in the patient information sheet: “If, during the course of the study, you indicate that you are particularly unwell or if there are concerns about your baby’s health and welfare, you may benefit from talking to someone who can offer you further support. In this event we will ask if you would like us to refer you to the most appropriate health professional who will be able to advise you further (e.g. GP or health visitors)” (Patient Information Sheet, p.2)

5.14.6 Security

Data which contained personal identifiable information were kept securely in a locked cabinet in a locked office in the University. Access to data stored on the computer was *via* a password known only by the researcher.

5.15 Data analysis

Data analysis was undertaken using SPSS v.19, after consultation with a statistician, following a plan determined before the data were gathered.

5.15.1 Analysis for objective 1: Univariate analysis for postnatal outcomes

Descriptive statistics (frequencies, mean and 95% confidence intervals (CI)) were obtained on postnatal PTSD symptoms and other physical and psychological outcomes using univariate analysis.

5.15.2 Analysis for objective 2: Bivariate analysis for differences in postnatal outcomes in women with and without SMM

Outcome variables (PTSD symptoms and other physical and psychological outcomes at 6-8 weeks postpartum) in women with and without severe maternal morbidity were compared using Pearson's chi-square tests, Fisher's exact tests, T-tests, one-way ANOVA, and Kruskal-Wallis tests as appropriate (Table 5.5).

Table 5. 5 Statistical tests

	IES		EPDS		SF-12	BF	Health care use	
	≥20	mean	≥13	mean	mean	binary	binary	mean
Obstetric haemorrhage	χ^2, exact	ANOVA	χ^2, exact	ANOVA	ANOVA	χ^2	χ^2	ANOVA
Hypertensive disorders	Fisher's exact	Kruskal-Wallis	Fisher's exact	Kruskal-Wallis	Kruskal-Wallis	Fisher's exact	Fisher's exact	Kruskal-Wallis
HDU admission	χ^2	t-test	χ^2	t-test	t-test	χ^2	χ^2	t-test
All SMM	χ^2	t-test	χ^2	t-test	t-test	χ^2	χ^2	t-test

Note: IES for PTSD symptoms, EPDS for depression, SF-12 for general health, BF: breastfeeding

Pearson's chi-square test was used for variables that involved categorical outcomes. If Pearson's chi-square tests indicated a significant difference in an outcome between more than two groups, logistic regression was performed to identify which pair of groups had a statistically significant difference. Fisher's exact test[18] was also used "if any of the cells of an r-by-c (row by column) table were expected to have fewer than 5 subjects" (Katz 2006b, p.79).

A T-test was used to compare two groups on the normally distributed score, while one-way ANOVA was used to compare three or more groups on normally distributed score. When one-way ANOVA indicated that there were significant differences across groups, a Tukey HSD Post hoc test was further conducted to determine which groups differ from each other. Because of the Central Limit Theorem (CLT), which states "even when a variable is not normally distributed the sample mean will tend to be normally distributed" (Kirkwood 1988, p.29), some outcomes having skewed distributions were also treated as if they were normally distributed in analysis if the number was "large enough" and "there were no unduly influential points" (Katz 2006, p.81). The number required for the CLT to take effect

[18] Fisher's exact test for 2x2 tables (or the Fisher-Freeman-Halton Test for larger tables - an extension of Fishers Test) was used when one or more cells in cross table had an expected frequency of five or less. While the chi-square test assumes that each cell has an expected frequency of five or more, the Fisher's exact test has no such assumption and can be used regardless of how small the expected frequency is (Katz, 2006b).

depends on the level of skewedness, but a sample size of 30 or more is considered to be large enough, although larger sample size may be required for a highly skewed distribution in the group of interest (Katz 2006). The decision whether to use a parametric test or non-parametric test was therefore made with the combination of the number of cases in exposed group and the distribution of the outcome within the group.

Where it was considered that the CLT was not safely applied, non-parametric statistics - Kruskal-Wallis test[19] was used to compare three or more groups on the median scores. If the results of Kruskal-Wallis test indicated significant difference in outcomes across groups, then the post-hoc tests using the Bonferroni method was performed to identify which groups differ from each other.

5.15.3 Analysis for objective 3: Multivariable logistic regression for the relationship between SMM and PTSD symptoms

For multivariable logistic regression analysis, the exposure variable 'all SMM cases' was selected. As described earlier, 'all SMM cases' is as a dichotomous variable; SMM group (ie. women with major obstetric haemorrhage, severe pre-eclampsia/ eclampsia/HELLP and/or the HDU admission) or non-SMM group. Although arbitrary dichotomisation of continuous variables has frequently been criticised due to loss of information (Douglas et al. 2006), it should be emphasized that the primary objective of this study was to examine the association between women's severe maternal morbidity and PTSD symptoms. It was therefore necessary to use clinical dichotomisation thresholds for classifying women with and without severe maternal morbidity. In addition, using a dichotomous variable for severe maternal

[19] Kruskal-Wallis test is based on ranking subjects from lowest to highest on the value of interest and then summing the rank of each group (Katz, 2006b).

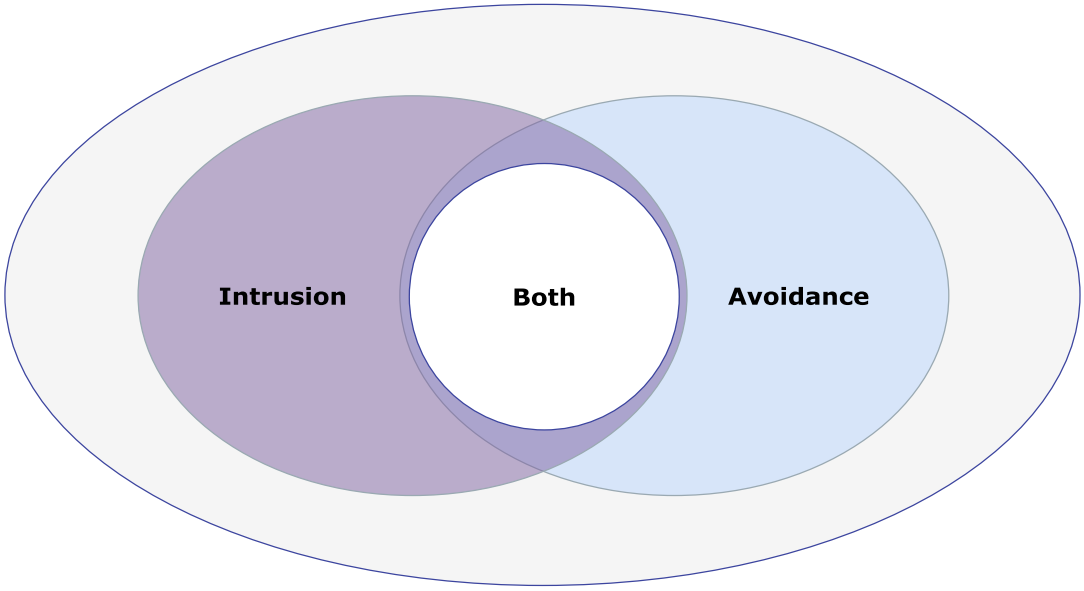
morbidity with locally used criteria (Waterstone et al. 2001, Waterstone et al. 2003) was considered to be more relevant to inform timely and appropriate management to minimise impact of severe maternal morbidity.

For the outcomes, three indicators of PTSD symptoms; intrusion; avoidance; and both intrusion and avoidance symptoms, measured with IES were used (the same outcomes used in bivariate analysis for Objective 2). As described earlier, these were also dichotomous outcomes. While there are disadvantages of the dichotomisation of continuous outcomes, such as losing information and requiring a large sample size to detect the differences between groups (Breitling, and Brenner 2009), analysis using dichotomous outcomes was considered to be more appropriate for this study, firstly because the study had a large sample and secondly it would provide clinically more relevant information than continuous outcomes.

For example, group differences in the outcomes would be detected with a smaller sample size using a continuous outcome, but these differences would be mean levels, and statistically significant differences would not necessarily be clinically significant. In addition, outcomes of PTSD symptoms were skewed. Treating the outcomes as linear, it probably requires variable transform and it becomes more difficult to reach clinical interpretations. The developer of the IES argued that “a clinically more relevant consideration has to do with how many people have high, medium or, low distress” (Horowitz 1982, p 721). Using a cut-off suggested by Horowitz (1982) to distinguish high level of distress from medium or low level of distress, intrusion symptoms were defined here as a score of at least 20 or more on the IES intrusion subscale, while avoidance symptoms were defined here as score of at least 20 or more on the IES avoidance scale. The outcome variable for ‘both intrusion and avoidance’ indicated women who had a score of 20 or more on both

IES intrusion and avoidance subscales. This higher threshold of PTSD symptoms was included, as this outcome was used in some previous studies (Ayers et al. 2007, Czarnocka and Slade 2000) and would provide more informative results, although numbers overlapped with other indicators (ie. the group of women with intrusion symptoms also included women who had both symptoms, and the group of women with avoidance symptom also included women with both symptoms) (Figure 5.1).

Figure 5. 1 Three indicators of PTSD symptoms



5.15.3.1 Adjusting for women's baseline characteristics

As described earlier, a numbers of variables related to women's baseline characteristics were considered to be potential confounders. Ideally all variables shown in prior research to be confounders should be included in the regression model. However, inclusion of a large number of variables in the model is problematic because the sample size of subgroups becomes small, meaning that the estimated risk becomes unstable (Katz, 2006a, p.122). Therefore several statisticians suggest the analysis should "exclude variables that are not empirically

operating as confounders" (Katz, 2006, p.82). Although there is no statistical test to identify a confounder, there are three criteria for confounders: (1) it must be a risk factor for the outcome; (2) it must be associated with the exposure (independent) variable in the source population and (3) it must *not* be affected by exposure (independent variable) or outcome (dependent variable) (Rothman and Greenland 1998, Katz 2006a). Following these criteria, the bivariate relationship of each variable of women's baseline characteristics was first examined with severe maternal morbidity and next with PTSD symptoms. If the variable was associated with both severe maternal morbidity and PTSD symptoms, then it was considered to be a confounder that needed to be controlled for. An alternative way of identifying important confounders suggested by Greenland (1989) was to run one model without the confounder and another with the confounder to see the change of the effect size of the exposure on outcomes. If it changes the effect size more than 10%, the variable would be a confounder that is worth considering. Therefore, in this study, a series of multivariable logistic regression models were developed to examine whether the effect size of severe maternal morbidity on PTSD symptoms changes by including each of the variables of women's basic characteristics in the model. These results eventually addressed the study objective: to determine whether there is an association between SMM and PTSD symptoms while adjusting for women's baseline characteristics. In addition, this process allowed identifying the important variables that would need to be included in the model in subsequent analysis.

5.15.3.2 Examining mediators

A series of logistic regression models was developed to examine whether the relationship between SMM and PTSD symptoms were mediated by women's perceived control during labour and birth, neonatal outcomes, obstetric intervention

and place of birth. For a variable to be a mediator, “first, the independent variable must affect the mediator…, second, the independent variable must be shown to affect the dependent variable…, and third, the mediator must affect the dependent variable”. From these statements, it is clear that confounders and mediators are statistically similar. However, Baron and Kenny added another criterion for mediators which is after meeting the three criteria above,“…then the effect of the independent variable on the dependent variable must be less in the third equation than in the second.” (Baron and Kenny 1986, p.1177). The analysis therefore started with examining the relationship between SMM (independent variable/exposure) and women’s perceived control during labour and birth (potential mediator). Next, bivariate relationship between women’s perceived control during labour and birth (potential mediators) and PTSD symptoms (dependent variable/outcome) were tested. If women’s perceived control during labour and birth showed a statistical significance with both SMM and PTSD symptoms, then multivariable logistic regression models were developed to see if adding the variable of women’s perceived control during labour and birth reduced the effect size of SMM on PTSD symptoms. The same process was repeated to test the mediation effect of neonatal outcomes, obstetric intervention and place of birth.

5.15.3.3 Taking into account postnatal factors

To test for a possible effect modification of postnatal social support and other perceived stressful events respectively, on the relationship between SMM and PTSD symptoms, ‘interaction terms’ (a function of SPSS to evaluate effect modification) were used in the regression model. If the results did not indicate the presence of effect modification (in other words, interaction terms were not significantly associated with PTSD symptoms), they were treated as potential risk

factors and simply adjusted for in the multivariable logistic regressions model without using the interaction term.

5.16 Chapter summary

This chapter has described, explained and justified the aim, objectives and methods of the study. As described, a prospective cohort study was undertaken among women who gave birth in one inner city maternity unit in England to assess the impact of women's experiences of severe maternal morbidity (SMM) on their postnatal outcomes. The results of analyses are divided into three subsequent chapters, with sample characteristics presented in Chapter 6, postnatal outcomes and their relationship with severe maternal morbidity (Objectives 1 and 2) in Chapter 7, and the relationship between severe maternal morbidity and PTSD symptoms (Objective 3) in Chapter 8.

Chapter 6

Response rate and sample characteristics

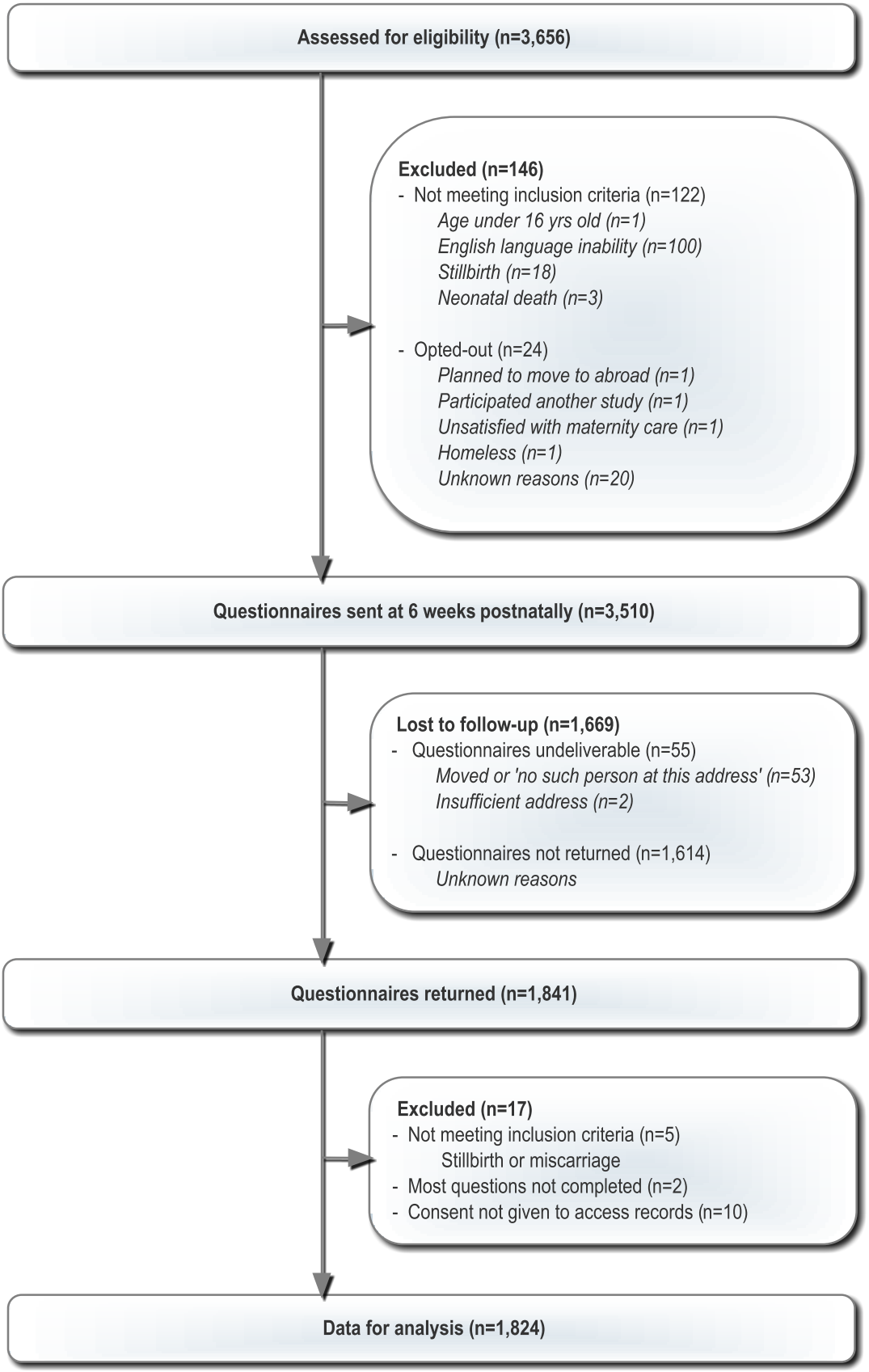
This chapter describes the response rate and sample characteristics of the study participants. Descriptive statistics presented include the socio-demographic characteristics of the participants, their medical and psychological risk factors before and during pregnancy, model of care and the outcomes of the index pregnancy and birth outcomes, including mode of birth, neonatal outcomes and severe maternal morbidity. The extent to which the study sample represents the entire population is examined briefly, based on comparing basic characteristics of respondents and non-respondents of the follow-up postnatal questionnaire.

6.1 Response rate and time of completion

During the data collection period from 7th June to 21st December 2010, a total of 3,656 women gave birth after 24 weeks gestational age, of which 122 women were excluded because of age ineligibility (n=1), language inability (n=100) or because they had experienced a stillbirth (n=18) or neonatal death (n=3). Of the potentially eligible women (n=3,534), 24 women declined to participate because of a plan to move to abroad (n=1), participating in another study (n=1), unsatisfied with maternity care (n=1), homeless (n=1) and unknown reasons (n=20). In total, 3,510 questionnaires were sent to women six weeks after giving birth. A total of 55 women could not be contacted by mail and the questionnaires were returned to the study office, having been undelivered due to incorrect address or because the intended recipient had moved. A total of 1,841 questionnaires were returned completed (53% response rate, excluding 55 women who could not be reached from the denominator), although a further five questionnaires had to be excluded because

they were completed by women who had suffered a stillbirth or miscarriage. This occurred partially due to the amendment made to the study inclusion and exclusion criteria during data collection (women with stillbirth and neonatal death were initially included and later excluded) as explained in the methods section (chapter 5). Two further questionnaires were excluded as most questions were not completed as were ten questionnaires from women who did not provide consent to access their clinical records. Finally, 52% of all eligible women participated in the study. Figure 6.1 shows the flow of participants through the study. The time of questionnaire completion ranged from 5 to 16 weeks with 74.2% of respondents completing the questionnaire 6-8 weeks postnatally. The completion rate at 10 weeks postnatally was 93%.

Figure 6. 1 Flow of participants through the study



6.2 Sample characteristics

6.2.1 Demographic and socio-economic characteristics

The socio-demographic characteristics of the study participants were indicated by age, parity, ethnic group, educational qualification and an Index of Multiple Deprivation (IMD).

Age

The mean age of the study participants was 32.3 years (range 17 to 50, SD=5.2 years). The largest numbers of women were in the 30-34 year range (39.3%) followed by 35-39 year range (26.9%). Only 1.2% of the women were under 20 years old. The age demographics of the study participants are detailed in Table 6.1.

Table 6. 1 Age at delivery

	Frequency	Percentage	Mean	SD	Range
Age at delivery (continuous)			32.3 yrs	5.24	17-50
Age-group					
Under 20	21	1.2%			
20-24	142	7.8%			
25-29	328	18.0%			
30-34	717	39.3%			
35-39	491	26.9%			
40 +	125	6.9%			
(Missing)	(0)	--			
Total	**1824**				

Parity

From the 1,824 participants in this study, 64.9% were primiparous (women who gave birth for their first time) and 35.1% were multiparous (parity range: one to eight). The majority of multiparous women gave birth to their second (parity 1) or third child (parity 2). The proportion of women who gave birth to their fourth or more child was only 1% (n=18). The parity demographics of the study participants are detailed in Table 6.2.

Table 6. 2 Parity

Parity	Frequency	Percentage	Mean	SD	Range
Parity (discrete)			0.5	0.83	0-8
Parity					
0	1184	64.9%			
1	447	24.5%			
2	144	7.9%			
3	31	1.7%			
4+	18	1.0%			
(Missing)	(0)	--			
Total	**1824**				

Ethnic groups

Based on the ethnic group classification of the Office for National Statistics (ONS 2011), 60.5% of the study participants were categorised as White. Black women comprised 23.7% of the study participants, and Asian women 8.7%. The percentage of women who were either in mixed ethnic groups or other ethnic groups was 7.2% (Table 6.3).

Table 6. 3 Ethnic group classification

ONS categories (%, n)	ONS sub-categories (n)	Participants' genetic ethnicity (n)
1. White (n=1,103; 60.5%)	• English/ Welsh/ Scottish/Northern Irish/ British (n=652)	British (n=612) English (n=33) Scottish (n=5) Welsh (n=2)
	• Irish (n=27)	Irish (n=27)
	• Any other White background (n=424)	White-Italian (n=8) Portuguese (n=13) Greek (n=1) White-Polish (n=24) Other white/mixed European (n=40) All former USSR Republics (n=8) Croatian (n=1) Serbian (n=2) Albanian (n=2) Turkish Cypriot (n=3) Other former Yugoslavia (n=2) White-Any Other (n=259) Other white unspecified (n=61)
2. Mixed/ Multiple ethnic (n=45; 2.5%)	• White and Black Caribbean (n=14) • White and Black African (n=8) • White and Asian (n=12)	White and Black Caribbean (n=14) White and Black African (n=8) White and Asian (n=7) Chinese and White (n=5)
	• Any other Mixed/Multiple ethnic (n=11)	Mixed-Any Other (n=8) Mixed-Other Unspecified (n=3)
3. Asian (n=158; 8.7%)	• Indian (n=38) • Pakistani (n=9) • Bangladeshi (n=7) • Chinese (n=48) • Any other Asian background (n=56)	Indian/British Indian (n=38) Pakistani/British Pakistani (n=9) Bangladeshi/British Bangladeshi (n=7) Chinese (n=48) Sinhalese (n=1) Sri Lankan (n=2) Filipino (n=3) Malaysian (n=2) Vietnamese (n=7) Japanese (n=3) Asian-Any Other (n=21) Other Asian unspecified (n=9) Mixed Asian (n=1) British Asian (n=4) East African Asian (n=1) Caribbean Asian (n=2)
4. Black (n=432; 23.7%)	• Black Caribbean (n=69) • Black African (n=281)	Caribbean (n=69) Ugandan (n=7) Angolan (n=2) Black African (n=3) Eritrean (n=9) Ghanaian (n=23) Nigerian (n=90) Other African (n=139) Somali (n=8)
	• Any other Black (n=82)	Black British (n=43) Black-Any Other (n=27) Mixed Black (n=6) Other Black Unspecified (n=6)
5. Other ethnic groups (n=86; 4.7%)	• Arab (n=17)	Arab (n=3) Kurdish (n=1) Iraqi (n=3) Iranian (n=1) Turkish (n=4) Middle Eastern (n=5)
	• Any other ethnic group (n=69)	Colombian (n=6) Ecuador (n=1) Other Latin American (n=14) Other-Any Ethnic Group (n=19) Any other group (n=8) Not Stated (n=21)

Education qualification

When asked about their highest level of educational qualification, 68.5% of participants had a degree or equivalent (or above) educational qualification. This number could include any educational qualification higher than A level such as a diploma (eg. Diploma of Higher Education: DipHE), a certificate (Certificate of Higher Education: CertHE) or a work related higher education. The numbers of participants who had completed A-level and GCSE-level qualifications were 15.1% and 11.6%, respectively. The percentage of participants who had obtained no education qualification was 4.8%. The educational qualification of the study participants are detailed in Table 6.4.

Table 6. 4 Highest education qualification

Highest education qualification	Frequency	Percentage
None	86	4.8%
GCSE	207	11.6%
A-level	271	15.1%
Degree/equivalent or above	1,227	68.5%
(Missing)	(33)	--
Total	**1,824**	

Deprivation quintiles (IMD)

According to an Index of Multiple Deprivation (IMD) score based on postcode, 29% of participants were living in the most deprived areas and another 46% were in the second deprived areas. A small percentage of participants were located in the least or the second least deprived areas (2.6% and 6.9% respectively) (Table 6.5)

Table 6. 5 Deprivation quintiles (IMD)

IMD	Frequency	Percentage
Least	47	2.6%
Fourth	125	6.9%
Third	291	16.1%
Second	822	45.5%
Most	520	28.8%
(Missing)	(19)	--
Total	**1824**	

6.2.3 Pre-existing health condition

Because women's health status prior to pregnancy and postnatally might contribute to their experiences of severe maternal morbidity, data on pre-pregnancy body mass index (BMI) and mental health history were collected from maternity booking records.

BMI

The mean BMI of the study group prior to pregnancy was 24.4 kg/m^2 (median=23.2, range=12.7-60.6). Using the BMI classification of National Institute for Health and Clinical Excellence (2006) and the NHS Information Centre (NHSIC: Health and Information Centre, 2009), 13.2% (n=201) women were classified as obese (BMI of 30 or more) in this study sample (from 1,777 women whose data were available) (Table 6.6)

Table 6. 6 BMI

	Frequency	Percentage	mean	SD	Range
BMI (continuous)			24.4kg/m^2	4.92	12.7-60.6
BMI (kg/m^2)					
<18.5	47	2.6%			
18.5-24.9	1,129	63.5%			
25.0-29.9	401	22.6%			
30.0-34.9	142	7.9%			
35.0-39.9	37	2.1%			
≥40.0	22	1.2%			
(missing)	(47)	--			
Total	**1,824**				

Mental health history

Based on data from maternity booking note, 4% (n=72) of participants reported that they had mental health history defined as either depressive symptoms during pregnancy, mental illness prior or during pregnancy or family history of severe mental illness (Table 6.7).

Table 6. 7 Mental health history

Mental health history	Frequency	Percentage
No	1,725	96.0%
Yes	72	4.0%
(missing)	(27)	--
Total	**1,824**	

6.3 Pregnancy, labour, birth and neonatal outcomes

6.3.1 Place of birth

Place of birth was examined as the indicator of model of care. A total of 76.1% (n=1,388) of women gave birth in an obstetric unit, while 19.1% (348) delivered in a hospital alongside midwifery unit. A small number of women (n=51, 3%) had a planned birth at home, while 2% (n=37) had an unplanned birth outside of hospital, including in the Emergency Department and home without any health professional (Table 6.8).

Table 6. 8 Place of birth

Place of birth	Frequency	Percentage
Obstetric unit	1,388	76.1%
Alongside midwifery unit	348	19.1%
Planned home birth	51	2.8%
BBA	37	2.0%
(missing)	(0)	--
Total	**1,824**	

6.3.2 Outcomes of labour and birth

Mode of birth

With regard to mode of birth, more than half of the study participants (54.9%) had spontaneous vaginal delivery (SVD). The rate of vaginal breech birth was 0.4%. The overall operative vaginal delivery rate was 16.0% (ventouse and forceps rates were 9.2% and 6.8%, respectively). The overall caesarean birth rate was 28.6% (elective caesarean-section and emergency caesarean-section rates were 8.9% and 19.7%, respectively). As described in Chapter 5, Elective caesarean-section was further classified into elective section (planned) (7.7%) and semi-elective section (caesarean-section performed <24 hours after the decision for surgery was made) (1.9%). Similarly, emergency caesarean-sections were further classified according to urgency; emergency (caesarean-section performed <60 minutes after the decision for surgery made), urgent (<30 minutes) and crash (<20 minutes), and the proportion of women who had caesarean-section under such conditions were 11.9%, 4.4% and 2.7%, respectively (Table 6.9).

Table 6. 9 Mode of birth

Mode of birth	Frequency	Percentage
SVD	1,002	54.9%
Breech	8	0.4%
Forceps	125	6.9%
Ventouse	167	9.2%
Elective caesarean-section	141	7.7%
Semi-elective caesarean-section	35	1.9%
Emergency caesarean-section (<60 minutes)	217	11.9%
Urgent (<30 minutes)	80	4.4%
Crash (<20 minutes)	49	2.7%
(missing)	(0)	--
Total	**1,824**	

Manual removal of placenta

Only 1.8 % of the women (n=32) had manual removal of their placenta (Table 6.10).

Table 6. 10 Manual removal of placenta

Manual removal of placenta	Frequency	Percentage
No	1,270	69.6%
Manual removal	32	1.8%
N/A (caesarean-section)	522	28.6%
(missing)	(5)	--
Total	**1,824**	

6.3.2 Severe maternal morbidity

Women's experiences of severe maternal morbidity were defined as major obstetric haemorrhage, severe pre-eclampsia/eclampsia/HELLP (haemolysis, elevated liver enzymes and low platelet count) syndrome and/or admission to intensive care unit (ICU) or high dependency unit (HDU) after delivery (any case).

Major obstetric haemorrhage

A total of 4% of women had a major obstetric haemorrhage defined as an estimated blood loss of ≥1,500ml (either vaginal or caesarean-section related) or a blood transfusion of ≥ 4 units during birth or immediately after birth. Another 33.4% of women had a mild obstetric haemorrhage (defined as an estimated blood loss of more than 500ml but less than 1500ml or received blood transfusion of one to three units). The proportion of women whose estimated blood loss was less than 500ml and who did not require any blood transfusion was 62.6% (Table 6.11).

Table 6. 11 Obstetric haemorrhage

Obstetric haemorrhage	Frequency	Percentage
None (<500ml; no transfusion)	1,137	62.6%
Mild (>=500ml,< 1,500ml; transfusion 1-3 units)	606	33.4%
Major (>=1,500ml, <2,500ml; transfusion 4+ units)	73	4.0%
(missing)	(8)†	--
Total	**1,824**	

† Numbers were missing for the estimated blood loss, but none of these missing cases had blood transfusion.

It has been acknowledged that caesarean birth leads to a higher blood loss than vaginal birth (Knight et al. 2009). In the current study, women who had undergone caesarean-section had higher rates of mild obstetric haemorrhage (66.3% for elective caesarean-section and 67.4% for emergency caesarean section) than women who had vaginal birth (14.2% for SVD and 39.1% for assisted virginal birth: breech, forceps or ventouse). When considering major obstetric haemorrhage, the highest rate was observed for women who had emergency caesarean-section (7.3%) followed by women who had assisted vaginal birth (6.4%) (Table 6.12).

Table 6. 12 Obstetric haemorrhage by mode of birth

	Obstetric haemorrhage			
Mode of birth	**None**	**Mild**	**Major**	**Total**
SVD	838 (83.8%)	142 (14.2%)	20 (2.0%)	1,000 (100.0%)
Breech/Forceps/Ventouse	162 (54.5%)	116 (39.1%)	19 (6.4%)	297 (100.0%)
Elective caesarean-section	47 (28.8%)	108 (66.3%)	8 (4.9%)	163 (100.0%)
Emergency caesarean-section	90 (25.3%)	240 (67.4%)	26 (7.3%)	356 (100.0%)
Total	**1,137 (62.6%)**	**606 (33.4%)**	**73 (4.0%)**	**1,816 (100.0%)**

Pre-eclampsia/Eclampsia/HELLP syndrome

Based on clinical records, 7.4% of women (n=136) had a hypertensive disorder including pre-eclampsia and eclampsia, although for some cases of hypertension it was difficult to distinguish between pre-existing or pregnancy induced hypertensive disorders. Of women with a hypertensive disorder, eleven cases were classed as having severe pre-eclampsia, of which four women developed eclampsia. Details of the timing of occurrence of eclampsia were not clearly stated in the women's clinical records, but all cases occurred during labour and birth or immediately after birth. One woman who had eclampsia also had HELLP syndrome (Table 6.13).

Table 6. 13 Severe maternal morbidity

	Frequency	Percentage
Pre-eclampsia/eclampsia		
No	1,688	92.5%
Hypertension	83	4.5%
Pre-eclampsia	42	2.3%
Severe pre-eclampsia	7	0.4%
Eclampsia	4	0.2%
(missing)	(0)	--
HELLP syndrome		
No	1,823	99.9%
Yes	1	0.1%
(missing)	(0)	
Total	**1,824**	

HDU admission

Of the 1,824 participants, a total of 103 (5.6%) women were admitted to the HDU for critical care (Table 4.14), but none were transferred to the intensive care unit (ICU). After examination of the indications for HDU admission in each case, one case was excluded due to the reason provided for admission being ‘no other bed available'. Although the information on the indications for HDU admission was unclear from the clinical records for some cases, the most common obstetric reasons were haemorrhage followed by hypertensive disorder including pre-eclampsia and eclampsia. Non-obstetric reasons included recovery from caesarean birth (possibly anaesthesia related reasons), bladder damage during the caesarean birth and pre-existing disorders (e.g. sickle cell disease, haematological disease, anaemia). Table 6.15 details the indications for admission to the HDU. Because women often had multiple complications (e.g. obstetric haemorrhage and pre-eclampsia), the numbers overlap each other.

Table 6. 14 Women admitted to the HDU

Admitted to the HDU	Frequency	Percentage
No	1,721	94.4%
Yes	103	5.6%
(missing)	(0)	
Total	**1,824**	

Table 6. 15 Indications for HDU admission

	Frequency	Percentage
Obstetric haemorrhage	**54**	**52.9%**
PPH (≥1,500mls)	17	
PPH (500≤, <1,500mls)	11	
Haemorrhage related to CS and/or placenta praevia in AN (≥1,500mls)	14	
Haemorrhage related to CS and/or placenta praevia in AN (500≤, <1,500mls)	12	
Hypertensive disorder	**21**	**20.6%**
Eclampsia in labour	2	
Severe pre-eclampsia	7	
Pre-eclampsia	5	
Hypertension	7	
Recovery from CS	**25**	**24.5%**
Pre-existing disorders	**9**	**8.8%**
Sickle cell disease	3	
Haematological disease	1	
Diabetes	5	
Others	**2**	**1.9%**
Bladder damage during CS	1	
Unknown	1	

Note: Percentage (numbers) does not add up to 100% (n=102) because some women had more than one condition.
AN: antenatal; CS: caesarean-section; PPH**:** postpartum haemorrhage

All severe maternal morbidity cases

Of the study participants, 147 (8.1%) experienced one of the three conditions of severe maternal morbidity (major obstetric haemorrhage, severe pre-eclampsia/eclampsia/HELLP syndrome, or HDU admission). It should be noted that there were eight women with missing information on the estimated blood loss, however blood transfusion records showed none had received a transfusion. Among women who did not have a transfusion, the chance of having a major obstetric haemorrhage was considered to be very small, with only 2% in this group having an estimated blood loss greater than 1,500ml. The missing cases were therefore put in the category of non-major obstetric haemorrhage when the variable of 'all severe maternal morbidity cases' was created (Table 6.16).

Table 6. 16 All severe maternal morbidity

All SMM cases	Frequency	Percentage
No	1,677	91.9%
Yes	147	8.1%
(missing)	(0)	
Total	**1,824**	

† Numbers were missing for the estimated blood loss, but none of these missing cases had blood transfusion. SMM: severe maternal morbidity

6.3.3 Neonatal outcomes

Although this study focused on the association between women's experience of severe maternal morbidity and their postnatal outcomes, neonatal health outcomes were also taken into consideration as this was seen to affect the postnatal psychological health of the participants. Neonatal outcomes were measured using gestational age at birth, birth weight, Apgar scores and NICU admission. Because the denominator used for estimating incidence and prevalence of any health issues or conditions reported in this study was the number of women who gave birth and not the numbers of babies who were born, selecting a single baby was necessary for women gave birth to multiple babies. In this study 2% of the women (n=41 out of 1824) gave birth to twins and there were no triplet or higher birth orders. For the 2% of the women who had given birth to twins, the twin with the most significant health problems (lower birth weight, lower Apgar scores, NICU admission) was taken into account considering the effect on postnatal psychological health of the mother.

Gestational age at birth

The mean gestational age at delivery was 39.2 weeks (median=40 weeks) ranging from 24 to 44 weeks. The majority of babies (n=1,558, 85.4%) were born at full term (37-42 gestational weeks). The proportion of babies born preterm (before 37 weeks of pregnancy) was 7.9% (n=144), while another 6.6% (n=121) babies were born post-term (greater than 42 weeks of pregnancy) (Table 6.17).

Table 6. 17 Gestational age at birth

	Frequency	Percentage	Mean	SD	Range
Gestational age (continuous)			39.2 weeks	(2.1)	24-44
Gestational age at delivery					
<37 weeks	145	7.9			
≥37, <42 weeks	1,558	85.4			
≥42 weeks	121	6.6			
(missing)	(0)	--			
Total	**1,824**				

Birth weight

Infant birth weight ranged from 565g to 5,350g (mean=3,363g, median 3,400g). The majority of babies (82.1%) were born weighing more than 2,500g but less than 4,000g. The percentage of babies born with low birth weights (less than 2,500 grams) was 6.4% (5.5% and 0.9% for babies born weighing 1,500–2,499g and less than 1,500g, respectively). The proportion of babies weighing '4,000-4,499g' and '4,500g or over' at birth were 9.8% and 1.8%, respectively (Table 6.18).

Table 6. 18 Birth weight (g)

	Frequency	Percentage	Mean	SD	Range
Birth weight (continuous)			3,363g	576.6	565-5350 g
Birth weight (g)					
Under 1,500	16	0.9			
1,500 – 1,999	22	1.2			
2,000 – 2,499	78	4.3			
2,500 – 2,999	246	13.5			
3,000 – 3,499	695	38.3			
3,500 – 3,999	551	30.3			
4,000 – 4,499	179	9.8			
4,500 – 4,999	30	1.7			
5,000 and over	1	0.1			
(missing)	(6)	--			
Total	**1,824**				

Apgar scores

The Apgar score at one minute after birth ranged from 0 to 10 (mean=8.6, median=9.0). Most babies (93%) had a total score of between 7 and 10, while 6% had a score between 4 and 6. However, 1% of babies had Apgar scores less than 4

at one minute after birth. Apgar scores at five minutes after birth ranged from 0 to 10 (mean=9.7, median=10). Nearly all babies (99%) scored between 7 and 10. The percentage of babies who had a low score of 4-6 and 0-3 at five minutes after birth was 0.8% and 0.2%, respectively (Table 6.19).

Table 6. 19 Apgar Scores

	Frequency	Percentage	Mean	SD	Range
Apgar Score at 1 minute (disc.)			8.6	1.3	0-10
Apgar Score at 1 minute					
0-3	22	1.2			
4-6	113	6.2			
7-10	1,681	92.6			
(missing)	(8)	--			
Apgar Score at 5 minutes (disc.)			9.7	0.8	0-10
Apgar Score at 5 minutes					
0-3	3	0.2			
4-6	14	0.8			
7-10	1,801	99.1			
(missing)	(6)	--			
Total	**1,824**				

Disc.=discrete

NICU admission

A total of 4.8% (n=88) of new-borns were admitted to the neonatal intensive care unit (NICU) and another 0.8% (n=15) were admitted to the special care baby unit (SCBU). Neonatal outcomes were summarised in Table 6.20.

Table 6. 20 Admission to NICU/SCBU

Admission to NICU/SCBU	Frequency	Percentage
No	1,720	94.3%
SCBU	15	0.8%
NICU	88	4.8%
(missing)	(1)	--
Total	**1,824**	

6.4 Respondents vs. non-respondents

The basic characteristics of respondents to the follow-up postnatal questionnaire were compared to that of non-respondents, where data were available. There was an overall difference in maternal age at delivery, parity, ethnic groups and the IMD. Non-respondents were significantly younger than respondents ($t=-10.60$, $p<0.001$). There was a higher response rate from women aged 30 years and above, with fewer responses from women aged 29 years and under ($p<0.001$). The proportion of primiparous women who responded was significantly higher than multiparous women ($p<0.001$). There was an overall significant difference in ethnic groups ($p<0.001$) such that responders were more likely to be white, and black women were less likely to respond in the study. Women living in less deprived areas were significantly statistically more likely to respond than those women living in the most deprived areas ($p<0.001$). Level of education was not comparable as it was collected via the questionnaire, and therefore data were not routinely available for non-respondents.

Regarding pregnancy outcomes, there was no statistically significant difference in gestational age at birth between respondents and non-respondents. There was no difference between respondents and non-respondents in the proportion of women who had severe obstetric haemorrhage. It was not possible to ascertain accurately how many non-respondents experienced eclampsia. However, from the HDU admission records, two cases of HELLP syndrome were identified during the data collection period and one of these woman participated in the study. Three women were admitted to ICU and one woman had a hysterectomy, but none of them participated in this study. However, with such a small number, statistical tests to see the differences between respondents and non-respondents were meaningless and

therefore not conducted. The proportion of babies with low Apgar scores (six or less) at five minutes was similar in the respondents and non-respondents. However, overall, there was a statistically significant difference in mode of birth ($p<0.001$) with respondents having slightly more instrumental and slightly fewer SVDs compared to non-respondents. Table 6.21 illustrates socio-demographic characteristics and pregnancy outcomes of respondents and non-respondents of the follow-up questionnaire.

Table 6. 21 Socio-demographic characteristics and pregnancy outcomes (respondents vs. non-respondents)

	All		Respondents		Non-respondents		P-value
	N, mean	%, SD	N, mean	%, SD	N, mean	%, SD	
Age at delivery (cont.)	31.3 y	(SD=5.65)	32.3 yrs	(SD=5.25)	30.3 yrs	(SD=5.88)	<0.001
Age at delivery							
≤19	72	2.1%)	21	1.2%	51	3.0%	<0.001
20-24	404	11.5%	142	7.8%	262	15.5%	
25-29	736	21.0%	328	18.0%	408	24.2%	
30-34	1,269	36.2%	717	39.3%	552	32.8%	
35-39	810	23.1%	491	26.9%	319	18.9%	
40+	218	(6.2%	125	6.9%	93	5.5%	
(missing)	(0)	--	(0)	--	(0)	--	
Parity							
Primiparous	2,091	59.8%	1,182	64.8%	909	54.4%	<0.001
Multiparous	1,404	40.2%	642	35.2%	762	45.6%	
(missing)	(14)		(0)		(14)		
Ethnicity							
White	1,790	51.2%	1,103	60.5%	687	41.2%	<0.001
Black	1,111	31.8%	432	23.7%	679	40.7%	
Asian	306	8.8%	158	8.7%	148	8.9%	
Mixed/multiple	86	2.5%	45	2.5%	41	2.5%	
Other	200	5.7%	86	4.7%	114	6.8%	
(missing)	(16)		(0)		(16)		
IMD							
Least	66	1.9%	47	2.6%	19	1.1%	<0.001
Fourth	192	5.5%	125	6.9%	67	4.0%	
Third	432	12.5%	291	16.1%	141	8.5%	
Second	1,607	46.4%	822	45.6%	785	47.3%	
Most	1,166	33.7%	519	28.8%	647	39.0%	
(missing)	(46)		(20)		(26)		
Ges. age at birth							
mean	39.2	2.14%	39.3	2.23%	39.1	2.33%	0.08
Ges. age at birth							
<37	290	8.3%	146	8.0%	144	8.6%	0.80
≥37, <42	2,932	83.8%	1,530	83.9%	1,402	83.8%	
≥42	278	7.9%	148	8.1%	130	7.9%	
(missing)	(9)		(0)		(9)		
Mode of delivery							
SVD	1,988	57.3%	1,003	55.0%	985	60.0%	<0.001
Breech/instrumental	485	14.0%	299	16.4%	186	11.3%	
EICS	326	9.4%	163	8.9%	163	9.9%	
EmCS	668	19.3%	359	19.7%	309	18.8%	
(missing)	(42)		(0)		(42)		
Estimated blood loss							
<1,500ml	3,351	96.3%	1,746	96.1%	1,605	96.5%	0.56
≥1,500ml	128	3.7%	70	3.9%	58	3.5%	
(missing)	(30)		(8)		(22)		
Eclampsia							
No	3,508	--	1,824	--	1,685	--	--
Yes		--	4	--		--	
(missing)	(0)		(0)		(0)		
HELLP syndrome							
No	3,508	--	1,824	--	1,685	--	--
Yes	1	--	1	--	0	--	
(missing)	(0)		(0)		(0)		
Apgar at 5 minutes							
0-6	37	1.1%	17	0.9%	20	1.2%	0.44
7-10	3,446	98.9%	1,800	99.1%	1,646	98.8%	
(missing)	(26)		(7)		(19)		
Total	**3,509**		**1,824**		**1,685**		

y=years, cont=continuous

Chapter 7

Postnatal outcomes and the relationship with severe maternal morbidity

This chapter addresses the first and the second objectives of this thesis: to obtain data on the prevalence of postnatal PTSD symptoms and other postnatal outcomes; and to assess whether there are differences in postnatal PTSD symptoms and other postnatal outcomes between women with and without severe maternal morbidity. The chapter comprises two sections. The first section describes information obtained from a questionnaire sent at 6 – 8 weeks postpartum, including women's perceptions of control during labour, their postnatal health outcomes and postnatal recovery environment (i.e. other perceived stressful events, perceived social support and living arrangements in the postpartum period). The second section presents the results of a bivariate analysis which examines differences in postnatal outcomes between women who experienced severe maternal morbidity during their labour, birth and immediately after birth, and those who did not.

7.1 Results from the postpartum questionnaire

7.1.1 Women's perceptions of control during labour and birth

Women's perceptions of the level of control they had in relation to themselves and their environment during labour and birth were measured using a self-report scale, the Labour Agentry Scale (LAS). The mean LAS score among participants was 48.77 (score range=11 to 70 out of a possible range of 10 to 70). The higher the total score, the higher the level of perceived control. The item with the lowest score

in the study sample was “I felt relaxed”, indicating that, in general, women were less relaxed during labour and birth. In contrast, the items with higher mean scores were, “I felt like a failure” and “I felt I was with people who care about me” indicating a feeling of a failure was not common and more women felt they were cared for during labour and birth (Table 7.1).

Table 7. 1 Women's experiences of control during labour and birth (LAS mean scores)

	N	Mean	SD	95%CI	Range
1. I felt tense	1,796	4.24	2.11	4.14 to 4.34	1 to 7
2. I felt important†	1,798	4.75	2.22	4.64 to 4.85	1 to 7
3. I felt confident†	1,805	4.52	1.93	4.43 to 4.61	1 to 7
4. I felt in control†	1,806	4.13	2.05	4.04 to 4.23	1 to 7
5. I felt fearful	1,794	4.71	2.02	4.61 to 4.80	1 to 7
6. I felt relaxed†	1,803	3.42	1.99	3.33 to 3.51	1 to 7
7. I felt good about my behaviour†	1,797	5.39	1.85	5.31 to 5.48	1 to 7
8. I felt helpless (powerless)	1,800	5.16	1.99	5.06 to 5.25	1 to 7
9. I felt I was with people who care about me†	1,808	6.09	1.57	6.01 to 6.16	1 to 7
10. I felt like a failure	1,798	6.40	1.33	6.34 to 6.46	1 to 7
Total LAS score	1,739	48.77	11.88	48.21to 49.33	11 to 70

Note: Women rated each item on a 7-point scale from 1 = ‘almost all of the time’ to 7 = ‘never, or almost never’. The positively worded items† (2, 3, 4, 6, 7 and 9) were reversed before a total score was obtained for analysis. The possible total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control. The higher the total score, the higher the level of experienced control. SD: standard deviation; CI: confidence interval

7.1.2 PTSD symptoms – Impact of Event Scale (IES)

PTSD symptoms were measured using the Impact of Event Scale (IES). In the IES, women were asked to rate fifteen items that measured the frequency of symptoms related to intrusion and avoidance during the past week, referring to an event or experience during their labour, the birth of their baby, or immediately after the birth (within 24 hours) that made them feel anxious and frightened. The study did not specify a particular event. In this section, the mean score of the IES is first presented followed by the prevalence of PTSD symptoms.

Mean IES scores

The mean score, standard deviation (SD) and 95% confidence interval (CI) were calculated for each item[20]. The scores were also summed to produce the total score and the total subscale scores (for intrusion and avoidance). Overall, the IES scores showed a highly skewed distribution indicating that the majority of women at 6-8 weeks postpartum had no or a low level of distress. The highest mean score was observed for the item, 'pictures about it popped into my mind' followed by the item, 'I avoided letting myself get upset when I thought about it and was reminded of it'. The mean of the total score of the IES for study participants was 11.13 (range 0 to 69). The mean score of each subscale of intrusion and avoidance was 5.79 (range 0 to 35) and 5.36 (range 0 to 40) respectively. Table 7.2 shows the mean score of each item of the IES as well as the mean of the total IES score.

[20] Although the IES scores had a highly skewed distribution, due to the central limit theorem, it was considered to be safe to calculate the mean and 95% CI.

Table 7. 2 PTSD symptoms (IES mean scores)

	N	Mean	SD	95%CI	Range
1. I thought about it when I didn't mean to	1,798	1.04	1.53	0.97 to 1.11	0 to 5
2. I avoided letting myself get upset when I thought about it and was reminded of it	1,800	1.06	1.67	0.98 to 1.13	0 to 5
3. I tried to remove it from memory	1,800	0.81	1.55	0.74 to 0.88	0 to 5
4. I had trouble falling asleep or staying asleep because of pictures or thoughts about it	1,805	0.37	1.03	0.32 to 0.42	0 to 5
5. I had strong waves of feelings about it	1,799	1.03	1.58	0.96 to 1.11	0 to 5
6. I had dreams about it	1,806	0.39	1.05	0.34 to 0.44	0 to 5
7. I stayed away from reminders of it	1,805	0.45	1.17	0.40 to 0.50	0 to 5
8. It felt as if I didn't happen or wasn't real	1,799	0.73	1.40	0.66 to 0.79	0 to 5
9. I tried not to talk about it	1,804	0.49	1.21	0.44 to 0.55	0 to 5
10. Pictures about it popped into my mind	1,803	1.30	1.68	1.23 to 1.38	0 to 5
11. Other things kept making me think about it	1,802	0.84	1.41	0.77 to 0.90	0 to 5
12. I was aware that I still had a lot of feelings about it, but I didn't deal with them	1,802	0.55	1.19	0.50 to 0.61	0 to 5
13. I tried not to think about it	1,805	0.72	1.44	0.65 to 0.79	0 to 5
14. Any reminder brought back feelings about it	1,801	0.84	1.45	0.78 to 0.91	0 to 5
15. My feelings were kind of numb	1,798	0.59	1.25	0.53 to 0.65	0 to 5
Intrusion subscale total score	**1,783**	**5.79**	**7.33**	**5.45 to 6.13**	**0 to 35**
Avoidance subscale total score	**1,781**	**5.36**	**7.79**	**5.00 to 5.73**	**0 to 40**
Total IES score	**1,765**	**11.13**	**13.98**	**10.48 to 11.78**	**0 to 69**

Note: Women rated each item on a 4-point Likert scale, 0 = 'not at all', 1 = 'rarely', 3 = 'sometimes' and 5 'often'. The possible total score on intrusion sub-scale (items 1, 4, 5, 6, 10, 11 and 14) score ranges from 0 to 35. The possible total avoidance subscale (items 2, 3, 7, 8, 12, 13 and 15) score ranges from 0 to 40. The possible total score ranges from 0 to 75. The higher the total score, the higher level of distress. SD: standard deviation; CI: confidence interval.

Prevalence of PTSD symptoms

Of women who completed the IES (n=1765), a total of 35.2% (n=633) rated '0' on the IES total score, indicating that they did not have any intrusion and avoidance symptoms at 6-8 weeks postpartum. This might be because they did not experience any event involving a feeling of anxiousness or fear during labour or birth or immediately after. Alternatively, it might be because they did not develop any distress symptoms even if they had experienced such an event or because they had recovered from such an event by the time they completed the questionnaire (it was not possible to distinguish this). The remainder of the participants (64.8%, n=1,166)

indicated some level of distress symptoms referring to an event which occurred during labour or birth, or immediately after the birth.

Based on Horowitz's (1982, p.722) clinical criteria established for the IES (i.e. a score of '20 or more' in a subscale predicts high distress in which "diagnostic, evaluative, or treatment procedures are clearly warranted [as] the person is more likely to be in a problem or pathological category"), 6.4% of women had a clinically significant level of intrusion and 8.4% had a clinically significant level of avoidance symptoms (Table 7.3). The proportion of women who had a score of 20 or more on both the intrusion and avoidance subscales, and therefore had a total IES score of at least 40, was 3.5% (Table 7.4).

Table 7. 3 Prevalence of PTSD symptoms

IES	Subscale – Intrusion			Subscale - Avoidance		
	Frequency	Percentage	95%CI (%)	Frequency	Percentage	95%CI (%)
0-8 (low)	1,264	70.9%	68.8 to 73.0	1,359	76.3%	74.3 to 78.3
9-19 (medium)	405	22.7%	20.8 to 24.7	272	15.3%	13.6 to 16.9
20+ (high)	114	6.4%	5.3 to 7.5	150	8.4%	7.1 to 9.7
(missing)	(41)	--		(43)	--	
Total	**1,824**			**1,824**		

Note: Categories are based on clinical criteria established by the developer of the scale (Horowitz 1982, p.722)
'0-8': "no indication for further diagnostic, evaluative, or treatment procedures"
'9-19': "they may give a global indication of conditions that warrant further evaluation."
'20+': "diagnostic, evaluative, or treatment procedures are clearly warranted"

Table 7. 4 Both IES subscales subscale (avoidance and intrusion) scores ≥20

	Frequency	Percentage	95%CI (%)
At least one IES subscale <20	1,704	96.5%	95.7-97.4
Intrusion ≥20 AND avoidance ≥20 = 40+	61	3.5%	2.6-4.3
(missing)	(59)		
Total	**1,824**		

7.1.3 Depression - Edinburgh Postnatal Depression Scale (EPDS)

In order to measure depressive symptoms, women were asked to rate how they felt in the past seven days using the Edinburgh Postnatal Depression Scale (EPDS). The mean scores of the EPDS and the prevalence of risk of depression measured with the scale are presented below.

Mean EPDS scores

The mean EPDS score was 6.76 (range = 0 - 27). The item with the highest mean score was "I have been anxious or worried for no good reason" followed by the item "I have blamed myself unnecessarily when things went wrong". The self-harm item (item 10) had the lowest mean score. Table 7.5 shows the details of the results.

Table 7. 5 Depression - Edinburgh Postnatal Depression Scale (mean scores)

EPDS	N	Mean	SD	95% CI	Range
1. I have been able to laugh and see the funny side of things	1,812	0.39	0.66	0.36 to 0.42	0 to 3
2. I have looked forward with enjoyment to things	1,810	0.45	0.71	0.42 to 0.48	0 to 3
3. I have blamed myself unnecessarily when things went wrong	1,813	1.15	0.89	1.11 to 1.19	0 to 3
4. I have been anxious or worried for no good reason	1,812	1.23	0.96	1.18 to 1.27	0 to 3
5. I have felt scared or panicky for no very good reason	1,812	0.76	0.90	0.72 to 0.80	0 to 3
6. Things have been getting on top of me	1,807	1.07	0.77	1.03 to 1.10	0 to 3
7. I have been so unhappy that I have had difficulty sleeping	1,811	0.47	0.81	0.43 to 0.51	0 to 3
8. I have felt sad or miserable	1,813	0.70	0.76	0.66 to 0.73	0 to 3
9. I have been so unhappy that I have been crying	1,811	0.49	0.68	0.46 to 0.52	0 to 3
10. The thought of harming myself has occurred to me	1,811	0.10	0.41	0.08 to 0.12	0 to 3
Total	**1,785**	**6.76**	**5.10**	**6.53 to 7.00**	**0 to 27**

Prevalence of risk of depression

The prevalence depression risk was estimated using a cut-off of 13 on a total EPDS score. Of women who completed the EPDS (n=1,785), 14.1% (n=255) had a score of 13 or more, indicating they were at risk of major depression.

Table 7. 6 EPDS

EPDS	Frequency	Percentage	95% CI (%)
<13	1,553	85.9%	84.3 to 87.5
≥13	255	14.1%	12.5 to 15.7
(missing)	(27)	--	--
Total	**1,824**		

7.1.4 General health - SF-12

Women's general health status was measured using the SF-12 which produced two summary scales, a physical component summary scale (PHC-12) and a mental component summary scale (MHC-12). Overall, PHC-12 and MHC-12 scores were 48.82 (SD=9.15) and 48.51 (SD=9.63), respectively.[21]

7.1.5 Breast feeding practice

Women were asked if they had breastfed their babies at any time since they were born. Almost all women (95%) had breastfed their baby at least once; 5% of women had never breastfed their babies (Table 7.7). The proportion of women who were breastfeeding exclusively at 6-8 weeks postpartum was 52.1%, while 32.2% of women were feeding breast and formula milk. Some women (10.6%), however, stopped breastfeeding at some point within 6-8 weeks postpartum (Table 7.8).

[21] As mentioned in Chapter 5 (Methods), the summary scales of PHC-12 and MHC-12 were obtained using the SF-12 manual developed in the US. While US SF-12 uses a 5-point response scale, UK SF-12 uses a 6-point Likert scale to answer the question, "Has your health limited your social activities like visiting friends or close relatives?".
In this study, 129 out of 1,824 participants rated '3: 'a good bit of the time' (no such a response option in US SF-12).
To get the summary score of PHC-12 and MHC-12, the answer was combined to the next closest response option '4: some of the time' on the Likert scale (results presented in the text). The answer was also combined to the closest response option on the other side '2: most of the time'. Results were almost the same (with latter method, PHC-12 and MHC-12 were 48.77 (SD=9.19) and 48.33 (SD=9.79) respectively).

Table 7. 7 Have you breastfed your baby at any time since he or she was born?

Breast feeding since baby was born	Frequency	Percentage	95% CI (%)
No	91	5.0%	4.0 to 6.0
Yes	1,727	95.0%	94.0 to 96.0
(missing)	(6)	--	--
Total	**1,824**		

Table 7. 8 Breastfeeding practice at 6-8 week postpartum

Breast feeding	Frequency	Percentage	95% CI (%)
Never	91	5.0%	4.0 to 6.0
Stopped breastfeeding	193	10.6%	9.2 to 12.1
Breast milk plus formula	584	32.2%	30.1 to 34.3
Only breast milk	945	52.1%	49.8 to 54.4
(missing)	(11)	--	--
Total	**1,824**		

7.1.6 Health service use

A number of indicators were used to measure women's health service use following their birth, which included the number of routine home visits made by midwives and health visitors, the six to eight week-postnatal check with their GP, non-routine visits to healthcare professionals and hospital readmission.

The number of routine home visits by midwives and health visitors

On average, the number of home visits women had during the 6-8 week postnatal period was 2.7 by midwives and 1.4 by health visitors.

Table 7. 9 Routine home visits by midwives and health visitors

Routine home visits	Mean	SD	95%CI	Range
Midwives	2.74	1.4	2.68 to 2.81	0 to 6+
Health visitors	1.37	0.80	1.33 to 1.40	0 to 6+

Routine postnatal check by GP

A total of 81.2% women had visited their GP for their routine 6 to 8 postnatal check, while 18.8% women had not had their postnatal check by the time of answering the questionnaire (Table 7.10).

Table 7. 10 Routine postnatal check by the GP

Routine postnatal check in GP	Frequency	Percentage	95%CI (%)
No	334	18.8%	17.0 to 20.6
Yes	1,446	81.2%	79.4 to 83.0
(missing)	(44)	--	--
Total	**1,824**		

Non-routine visits to healthcare professionals

Reports of visits to healthcare professionals, apart from the routine postnatal check with the GP, are shown in Table 7.11. A total of 60.5% women (n=1,093) visited healthcare professionals for themselves (n=618) and/or for their babies (n=879). The most common place women went was their GP practice followed by their hospital postnatal clinic. Women also visited community clinics, children's centres and other places which included accident and emergency, walk in centres/clinics, private clinics, physiotherapy and breastfeeding café/clinics. The reasons for visits to healthcare professionals varied. The most frequently reported reasons for visiting a GP were wound problems (caesarean-section or perineal) (10.9%, n=76), followed by baby skin problems (rash, spots, acne) (8.8%, n=61) and mastitis (5.8%, n=40). Similarly, the most common reasons for visiting hospital postnatal clinics were wound problems (17.6%, n=33) followed by infant concerns such as jaundice (16.6%, n=31), weight loss or weight check (6.4%, n=12). The details are described in Table 7.12.

Table 7. 11 Non-routine visits to healthcare professionals

Non-routine visits to healthcare professionals	Frequency	Percentage	95%CI (%)
No	714	39.5%	(37.3 to 41.8)
Yes	1,093	60.5%	(58.2 to 62.7)
(missing)	(17)	--	--
Total	**1,824**		

Table 7. 12 If women had non-routine visits to healthcare professionals (n=1,093), for whom, where and why?

	Frequency	Percentage
For whom?		
For mother	618	56.8%
For baby	879	80.8%
(missing)	(5)	--
Where?		
GP practice	761	69.6%
Hospital postnatal clinic	209	19.1%
Community clinic	187	17.1%
Children's centre	174	15.9%
Other	267	24.4%
(missing)	(4)	--
Why? (common reasons)		
GP practice (n=761)		
Wound problems (caesarean-section or perineal)	76	10.9%
Baby's skin problems (rush, spots, acne)	61	8.8%
Mastitis	40	5.8%
Baby URI, cold, cough, bronchitis	36	5.2%
Body pain (backache, abdomen etc.)	32	4.6%
Hospital postnatal clinic (n=209)		
Wound problems (caesarean-section or perineal)	33	17.6%
Baby's jaundice	31	16.6%
General check	13	7.0%
Baby heavy weight loss/weight check	12	6.4%
Blood pressure	5	2.7%
Community clinic (n=187)		
Baby's heavy weight loss/weight check	64	37.9%
Problems or support for breastfeeding	39	23.1%
General check	20	11.8%
Baby's fever	12	7.1%
Baby's jaundice	6	3.6%
Children's centre (n=174)		
Problems or support for breastfeeding	51	31.5%
Baby's heavy weight loss/weight check	44	27.2%
General check	16	9.9%
Baby's jaundice	7	4.3%
Baby's fever	7	4.3%
Other (n=252)		
Baby's jaundice	20	7.9%
Problems or support for breastfeeding	18	7.1%
Wound problems (caesarean-section or perineal)	14	5.6%
Baby's heavy weight loss/weight check	13	5.2%
Baby's reflux, stomach problem	11	4.4%

Hospital readmission

Based on women's self-reports, 5.2% (n=94) of study participants were re-admitted to hospital (Table 7.13). Of these women, 56% were re-admitted within seven days of the birth (ranged from the same day of the discharge to 67 days, mean=12.2). Most frequently reported reasons were problems with wound problems (caesarean-section or perineal wound) followed by infant feeding and excessive vaginal bleeding (Table 7.14).

A total of 7.9% (n=144) of women reported that their babies were readmitted to hospital. The most common reason was weight loss followed by jaundice (Table 7.15). A substantial proportion of reasons for readmission (38.6%) were included in the category of 'others' partly because many women did not provide a specific reason, reporting reasons such as 'turned blue' 'sick' 'unwell'. A total of 52% of baby's hospital readmissions occurred within seven days after they were born (ranged from 1 to 56 days, mean=13.2).

Table 7. 13 Hospital re-admission

	Frequency	Percentage	95%CI (%)
Hospital readmission (mother)			
No	1,716	94.9%	93.8 to 95.9
Yes	93	5.1%	4.1 to 6.2
(missing)	(15)	--	--
Hospital readmission (baby)			
No	1,665	92.0%	90.8 to 93.3
Yes	144	8.0%	6.7 to 9.2
(missing)	(15)	--	--
Total	**1,824**		

Table 7. 14 Reasons for re-admission (mother)

Reasons for readmission	Frequency	Percentage
Wound problems(caesarean-section, episiotomy etc)	16	18.0%
Blood pressure	6	6.7%
Severe or persistent headache	2	2.2%
Fever/shivering/high temperature	3	3.4%
Excessive vaginal bleeding	8	8.9%
Endometritis, placenta left in womb	7	7.8%
Difficulty passing urine, UTI	1	1.1%
Body pain (backache, abdomen etc)	5	5.6%
Mastitis	2	2.2%
Feeding problem	8	9.0%
Others	31	34.8%
(missing)	(4)	--
Total	**93**	

Table 7. 15 Reasons for re-admission (baby)

Reasons for readmission	Frequency	Percentage
Reflux, stomach problem	5	3.6%
Excessive weight loss	26	18.6%
Jaundice	25	17.9%
Umbilical cord infection	1	0.7%
Skin problems (rush, spots, acne)	2	1.4%
Thrush	1	0.7%
Fever	7	5.0%
URI, cold, cough, bronchitis	15	10.7%
Heart disease	2	1.4%
Premature birth	2	1.4%
Others	54	38.6%
(missing for reasons)	(4)	--
Total	**144**	

7.1.7 Social support in the postnatal period

As a proxy of social support during the postpartum period, two indicators were used; a woman's living arrangements and their perceived social support.

Living arrangements

In the postnatal questionnaire, women were asked if they were living with any other adults. The majority of study participants were living with their partner (81.9%). The percentage of women who were living with no other adults was 7.7%, while those

who were living with their close family members (parents, sisters or brothers) or other adults (e.g. friends) were 7.5% and 2.9%, respectively.

Table 7. 16 Living arrangements

Living arrangements	Frequency	Percentage
Alone (no any adult)	138	7.7%
With partner	1,476	81.9%
With parents/sisters/brothers	136	7.5%
With other adults	52	2.9%
(Missing)	(22)	--
Total	**1,824**	

Perceived social support – Social Support Scale (SSS)

Women's perceived social support as measured by the social support scale (SSS) is presented in Table 7.17. A higher score indicated a greater perceived level of social support. The total score of the scale in this sample ranged from 0 (no support) to 30 (maximum support), with a mean score of 20.6. From the results, women appeared to have more support from their partner or family members and less support from neighbours or health and social service professionals.

Table 7. 17 Perceived social support

	N	Mean	SD	95%CI	Range
1. I have no one to share my feelings with	1,808	2.54	0.70	2.51 to 2.57	0 to 3
2. My partner provides me with the emotional support I need	1,802	2.11	0.97	2.06 to 2.15	0 to 3
3. There are other mothers with whom I can share my experiences	1,805	1.98	1.04	1.93 to 2.02	0 to 3
4. I believe in moments of difficulty my neighbours would help me	1,807	1.19	1.17	1.13 to 1.24	0 to 3
5. I am worried my partner might leave me	1,791	2.74	0.69	2.71 to 2.78	0 to 3
6. There is always someone with whom I can share my happiness and excitement about my baby	1,811	2.58	0.73	2.54 to 2.61	0 to 3
7. If I feel tired I can rely on my partner to take over	1,798	2.00	1.01	1.95 to 2.04	0 to 3
8. If I was in financial difficulty I know my family would help if they could	1,808	2.43	0.98	2.39 to 2.48	0 to 3
9. If I was in financial difficulty I know my friends would help if they could	1,799	1.75	1.19	1.70 to 1.81	0 to 3
10. If all else fails I know health and social services will look after me	1,794	1.23	1.13	1.18 to 1.29	0 to 3
Total	1,725	20.62	5.63	20.35 to 20.88	0 to 30

7.1.8 Other perceived stress events during postpartum period

To understand women's perceived stress during the postpartum period as a possible consequence of events other than giving birth, women were asked, "Aside from your birth, have you experienced any changes in your life within the last six weeks, which have caused you anxiety or depression?" A total of 219 women (12.1%) answered "yes", indicating they had faced additional sources of stress (Table 7.18). The most frequently reported event was a serious accident or illness of a family member, relative or close friend (15.1%), followed by moving (13.7%) and death of a family member, relative or friend (12.3%). Perceived stress events reported by women were coded into five categories. Details are shown in table 7.19.

Table 7. 18 Perceived stress event during postnatal period

Any changes in life that caused anxiety/depression	Frequency	Percentage	95%CI (%)
No	1,589	87.9%	86.4 to 89.4
Yes	219	12.1%	10.6 to 13.6
(missing)	(16)	--	--
Total	**1,824**		

Table 7. 19 Perceived stress event reported by women

Event			N	%
Bereavement	Partner	Death	1	0.5%
(n=28, 12.8%)	Family, relative, friend	Death (not including death of the baby)	27	12.3%
Serious accident or illness	Own illness	Hospital admission	1	0.5%
(n=49, 22.4%)		Serious accident or illness	7	3.2%
		Mental illness	3	1.4%
	Partner	Serious accident or illness	2	0.9%
	Family, relative, friend	Serious accident or illness	33	15.1%
		Mental illness	3	1.4%
Interpersonal relationship	With partners	Separation/divorce	4	1.8%
(n=38, 17.4%)		Partner did not want your child	1	0.5%
		Extramarital sexual affair	2	1.0%
		Serious argument	20	9.1%
	Family, relative, friend	Serious argument	11	5.0%
Financial issues/homeless	Losing Job	Partner lost his job	10	4.6%
(n=45, 20.5%)		Possibility of losing job after maternity leave	5	2.3%
	Financial difficulties	Significant drop in income	13	5.9%
		Major financial problem	13	5.9%
	Homeless	Became homeless	4	1.8%
Others	Burglary	Car or house was burgled	3	1.4%
(n=59, 26.9%)	Moving	Moving house	30	13.7%
	Housing issues	Flood from upstairs, plumber problems, renovation, lack of space	7	3.2%
	Away from partner	Partner started working abroad	3	1.4%
	Others	Identity crisis, domestic problems	5	2.3%
		Reasons missing	10	5.0%
Total			**219**	**100%**

7.2 Bivariate analysis of severe maternal morbidity and postnatal health outcomes

This section presents the results of bivariate analysis, which assessed differences in postnatal PTSD symptoms and other physical and psychological outcomes between women with and without severe obstetric morbidity (objective 2). As described earlier (in Chapter 5), severe maternal morbidity in this study was defined as: (i) major obstetric haemorrhage, (ii) severe PET/eclampsia/HELLP and (iii) HDU/ICU admission. Women who had any of the three conditions (major obstetric haemorrhage, severe PET/eclampsia/HELLP syndrome or HDU/ICU admission) were included in one dichotomous variable called 'all severe maternal morbidity cases: yes or no'.

The analysis started by exploring differences in postnatal outcomes between women who had major obstetric haemorrhage and those who had mild or no obstetric haemorrhage. Similarly, analysis was conducted to explore differences in postnatal outcomes between women with and without severe PET/eclampsia/HELLP syndrome, between women with and without HDU/ICU admission, and also between women with and without severe maternal morbidity (any of the three conditions; major obstetric haemorrhage, severe PET/eclampsia/HELLP syndromes or HDU admission).

7.2.1 Major obstetric haemorrhage and postnatal health outcomes

Major obstetric haemorrhage and PTSD symptoms (IES)

PTSD symptoms, as measured by the Impact Event Scale (IES), were treated firstly as a continuous variable (the mean IES scores) and secondly as a dichotomous variable (the proportion of women who scored 20 or more) for the three indicators of

PTSD symptoms: (i) intrusion, (ii) avoidance and (iii) both intrusion and avoidance symptoms.

Difference in the mean IES scores

One-way ANOVA indicated that there were overall differences in the mean total score of the IES across the three categories of obstetric haemorrhage (Table 7.20). A Tukey HSD Post Hoc test (the test to determine which groups differ from each other) showed statistically significant differences between each pair of groups (Table 7.21). The results showed that the severity of PTSD symptoms increased sequentially with the rise of estimated blood loss/unit of blood transfusion categories.

Looking at each subscale, the mean score of avoidance was significantly different across the three obstetric haemorrhage categories (Table 7.20). Further analysis indicated that the difference was observed between each pair of groups, indicating women with more blood loss had significantly more severe avoidance symptoms at 6-8 weeks postpartum (Table 7.21). Similarly, differences in the mean scores of the intrusion subscale were statistically significant across the three obstetric haemorrhage categories (Table 7.20). The Tukey Post Hoc test indicated that differences were highly statistically significant between the major obstetric haemorrhage group and the other groups, but the difference between mild obstetric haemorrhage group and no obstetric haemorrhage group did not reach statistical significance (P=0.053) (Table 7.21).

Table 7. 20 IES mean scores (PTSD symptoms) across obstetric haemorrhage groups

	No (n=1137) EBL<500ml AND no BT			Mild (n=606) EBL 500≤,<1500ml OR BT1-3			Major (n=73) EBL≥1500ml OR BT4+			
	Mean	(SD)	95%CI	Mean	(SD)	95%CI	Mean	(SD)	95%CI	P
Total mean	9.99	(13.33)	9.21-10.78	12.29	(14.56)	11.10-13.47	18.40	(15.30)	14.75-22.05	<0.001
Intrusion	5.31	(7.13)	4.89-5.73	6.17	(7.41)	5.57-6.77	9.55	(9.72)	7.61-11.49	<0.001
Avoidance	4.69	(7.35)	4.26-5.12	6.16	(8.20)	5.50-6.83	8.87	(8.82)	6.77-10.97	<0.001

Note: EBL= estimated blood loss; BT=blood transfusion.

Table 7. 21 Tukey HSD Post hoc tests - differences in IES mean score between obstetric haemorrhage groups

	Difference	95%CI	p
Total score mean			
Mild OH (EBL≥500,<1500ml & BT 1-3units) vs. No OH (EBL<500ml & no BT)	2.30	0.63 to 3.96	<0.01
Major OH (EBL≥1500 & BT≥4units) vs. No OH	8.41	4.41 to 12.41	<0.001
Major vs. Mild	6.11	2.01 to 10.22	0.001
Intrusion subscale mean			
Mild OH (EBL≥500,<1500ml & BT 1-3units) vs. No OH (EBL<500ml & no BT)	0.86	0.01 to 1.73	0.053
Major OH (EBL≥1500 & BT≥4units) vs. No OH	4.24	2.15 to 6.32	<0.001
Major vs. Mild	3.38	1.23 to 5.52	0.001
Avoidance subscale mean			
Mild OH (EBL≥500,<1500ml & BT 1-3units) vs. No OH (EBL<500ml & no BT)	1.43	0.55 to 2.39	0.001
Major OH (EBL≥1500 & BT≥4units) vs. No OH	4.18	1.95 to 6.41	<0.001
Major vs. Mild	2.71	0.42 to 4.99	0.015

Note: OH=obstetric haemorrhage; EBL= estimated blood loss; BT=blood transfusion.

Difference in the proportion of the IES score ≥20 across obstetric haemorrhage groups

Differences in the proportion of women who scored the IES≥20 between the obstetric haemorrhage groups were examined using Chi-square test and Fisher's exact test.[22] The results showed that the proportion of women who had an IES score of 20 or more on both subscales, intrusion and avoidance, increased with severity of obstetric haemorrhage (2.6%, 4.3% and 8.6% for the group with no, mild, major obstetric haemorrhage, respectively); a statistically significant finding (Fisher's exact test, P=0.013). Similarly the proportion of women with an IES intrusion sub score of 20 or more increased with severity of obstetric haemorrhage (5.6%, 7.0% and 12.7% for the group with no, mild and major obstetric haemorrhage,

[22] Fisher's exact test for 2x2 tables (or the Fisher-Freeman-Halton Test for larger tables - an extension of Fishers Test) was used when one or more cells in cross table had an expected frequency of five or less. While the chi-square test assumes that each cell has an expected frequency of five or more, the Fisher's exact test has no such assumption and can be used regardless of how small the expected frequency is (Katz 2006a).

respectively); these differences between groups were also statistically significant (Fisher's exact test, P=0.05). The difference in the proportion of women who had a score of 20 or more on the IES avoidance sub score was also highly significant between three groups (6.5%, 10.9% and 17.1%, for the group with no, mild or major obstetric haemorrhage, respectively, P<0.001) (Table 7.22).

Table 7. 22 Proportion of PTSD symptoms across obstetric haemorrhage groups

	No (n=1,137) EBL<500ml AND no BT		Mild (n=606) EBL 500≤,<1,500ml OR BT1-3		Major (n=73) EBL≥1,500ml OR BT4+		
	N	%	N	%	N	%	P
Both subscales (int & avo)							
<20 on at least one subscale	1,075	97.4%	558	95.7%	64	91.4%	0.0013
≥20 on both†	29	2.6%	25	4.3%	6	8.6%	
(missing)	(33)	--	(23)	--	(3)	--	
Intrusion subscale							
<20	1,053	94.4%	548	93.0%	62	87.3%	<0.05
≥20	62	5.6%	41	7.0%	9	12.7%	
(missing)	(22)	--	(17)	--	(2)	--	
Avoidance subscale							
<20	1,042	93.5%	525	89.1%	58	82.9%	<0.001
≥20	72	6.5%	64	10.9%	12	17.1%	
(missing)	(23)	--	(17)	--	(3)	--	

† Both=Intrusion subscale scores≥20 AND avoidance subscale scores≥20 (therefore scores≥40), int=intrusion, avo=avoidance

Logistic regression analysis also indicated that a statistical difference in PTSD symptoms only existed between the no obstetric haemorrhage and the major obstetric haemorrhage groups, except for avoidance symptoms where statistical differences existed between the no obstetric haemorrhage and mild obstetric haemorrhage groups (Table 7.23).

Table 7. 23 Bivariate logistic regression – PTSD symptoms across obstetric haemorrhage groups

	Frequency	ORs	95%CI	P
Both subscales (≥20 on both Int. & Avo)†				
No	1,137	1		
Mild OH	606	1.66	0.96-2.86	0.07
Major OH	73	3.48	1.39-8.67	0.008
(missing)	(8)	--	--	--
Intrusion subscales (≥20)				
No	1,137	1		
Mild OH	606	1.27	0.85-1.91	0.25
Major OH	73	2.47	1.17-5.19	0.018
(missing)	(8)	--	--	--
Avoidance subscales (≥20)				
No	1,137	1		
Mild OH	606	1.76	1.24-2.51	0.002
Major OH	73	2.99	1.54-5.83	0.001
(missing)	(8)	--	--	--
Total	**1,824**			

† Both=Intrusion subscale scores≥20 AND avoidance subscale scores≥20 (therefore scores≥40), int=intrusion, avo=avoidance

Major obstetric haemorrhage and postnatal depression (EPDS)

To examine differences in the mean EPDS scores between the three obstetric haemorrhage groups, a one way ANOVA was conducted. The results indicated the mean score of the EPDS were similar across three groups (P=0.69) (Table 7.24).

Table 7. 24 Difference in the mean EPDS scores across obstetric haemorrhage groups

	No (n=1,137) EBL<500ml AND no BT			Mild (n=606) EBL 500≤,<1500ml OR BT1-3			Major (n=73) EBL≥1500ml OR BT4+			
	Mean	(SD)	95%CI	Mean	(SD)	95%CI	Mean	(SD)	95%CI	P
EPDS total	6.71	(5.20)	6.41-7.02	6.79	(4.96)	6.39-7.19	7.24	(4.71)	6.13-8.34	0.69

Note: EBL= estimated blood loss; BT=blood transfusion.

The proportion of women who had an EPDS score of 13 or more at 6-8 weeks postpartum was also not statistically significantly different between the three levels of obstetric haemorrhage groups (p=0.59) (Table 7.25)

Table 7. 25 Difference in the proportion of women with EPDS scores ≥ 13 across obstetric haemorrhage groups

EPDS	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+		P
<13	950	(85.4%)	517	(87.2%)	61	(84.7%)	0.59
≥13	162	(14.6%)	76	(12.8%)	11	(15.3%)	
(missing)	(25)	--	(13)	--	(1)	--	
Total	**1,137**		**606**		**73**		

Note: there were 8 missing cases for obstetric haemorrhage.

Major obstetric haemorrhage and general health (SF-12)

Women's general health was measured with the physical and mental health component summary scores using SF-12 (PHC-12 and MHC-12). Results showed that there were statistically significant differences between three groups of obstetric haemorrhage in both the PHC-12 and MHC-12 (PHC-12: $F_{2,1694}$=49.91, P<0.001; MHC: $F_{2,1694}$=3.35, P<0.04). The Tukey HSD Post Hoc test further determined that there was a significant difference in PHC-12 between the no obstetric haemorrhage group and the other two groups. However, the PHC-12 between the mild obstetric haemorrhage and major obstetric haemorrhage groups was similar and there was no statistically significant difference between these two groups. Regarding the MHC-12, differences were only statistically significant between the group of women with no obstetric haemorrhage and the group of women with major obstetric haemorrhage, but not the other pairs of groups. Tables 7.26 and 7.27 summarise the results.

Table 7. 26 Difference in general health across obstetric haemorrhage groups

SF-12 (mean)	No (n=1137) EBL<500ml AND no BT			Mild (n=606) EBL 500≤,<1500ml OR BT1-3			Major (n=73) EBL≥1500ml OR BT4+			P
	Mean	(SD)	95%CI	Mean	(SD)	95%CI	Mean	(SD)	95%CI	
PHC-12†	50.47	(8.70)	49.95-50.99	46.21	(9.25)	45.44-46.98	44.75	(8.39)	42.75-46.75	<0.001
(PHC-12)‡	50.43	(8.73)	49.91-50.95	46.14	(9.31)	45.37-46.91	44.67	(8.43)	42.66-46.68	<0.001
MHC-12†	48.83	(9.69)	48.25-49.42	48.20	(9.53)	47.41-48.99	45.97	(9.08)	43.81-48.14	0.04
(MHC-12)‡	48.70	(9.32)	48.11-49.29	47.94	(9.72)	47.14-48.75	45.71	(9.84)	43.49-47.93	0.03

Note: EBL= estimated blood loss; BT=blood transfusion.

† Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '4: some of the time'

‡ Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '2: most of the time'.

Table 7. 27 Tukey HSD Post Hoc tests: differences in SF-12 between obstetric haemorrhage groups

	Difference	95%CI	p
PHC-12			
Mild OH (EBL≥500,<1500ml & BT 1-3units) vs. No OH (EBL<500ml & no BT)	-4.26 (-4.29)	-5.34 to -3.16 (-5.38 to -3.20)	<0.001 (<0.001)
Major OH (EBL≥1500 & BT≥4units) vs. No OH	-5.72 (-5.76)	-8.29 to -3.15 (-8.34 to -3.18)	<0.001 (<0.001)
Major vs. Mild	-1.46 (-1.47)	-4.10 to 1.17 (-4.12 to 1.18)	0.41 (0.40)
MHC-12			
Mild OH (EBL≥500,<1500ml & BT 1-3units) vs. No OH (EBL<500ml & no BT)	-0.64 (-0.75)	-1.82 to 0.54 (-1.95 to 0.45)	0.41 (0.30)
Major OH (EBL≥1500 & BT≥4units) vs. No OH	-2.87 (-2.99)	-5.65 to -0.08 (-5.82 to -0.16)	0.04 (0.04)
Major vs. Mild	-2.23 (-2.24)	- 5.09 to 0.63 (-5.14 to 0.67)	0.16 (0.17)

Note: OH=obstetric haemorrhage; EBL= estimated blood loss; BT=blood transfusion.
Figures without brackets ( ) shows scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '4: some of the time'. Figures in brackets ( ) shows the results obtained with a calculation in which answering 'good bit of the time' was combined with the answering option '2: most of the time'.

Major obstetric haemorrhage and breastfeeding practice

Differences in breastfeeding practice at 6-8 weeks postnatal between the three groups of women with obstetric haemorrhage were first examined by comparing the proportion of women who had (i) never breastfed; (ii) breastfed since the baby was born but stopped; (iii) fed their baby breast milk plus formula; and (iv) given breast milk only. There were no statistically significant differences between the three groups, but it is worth noting that the proportion of women who had never breastfed was higher for women with major obstetric haemorrhage (8.2%), compared to women with no haemorrhage or mild obstetric haemorrhage (4.8% for both groups) (Table 7.28). Differences between the three groups of obstetric haemorrhage were examined further by exclusive breastfeeding practice at 6-8 weeks postnatal. Chi-square tests showed that there were again no statistically significant differences across three groups (Table 7.29). Using the different categories in which breast milk plus formula and breast milk only were clustered and the rest of the practices (never and stopped) was clustered, there was again no statistically significant difference between the three obstetric haemorrhage groups (P=0.17) (data not shown).

Table 7. 28 Breastfeeding practice between across obstetric haemorrhage groups

	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+		P
	N	%	N	%	N	%	
Never	54	4.8%	29	4.8%	6	8.2%	0.21
Stopped breastfeeding (BF)	127	11.2%	55	9.1%	10	13.7%	
Breast milk plus formula	351	31.1%	213	35.4%	18	24.7%	
Only breast milk	598	52.9%	305	50.7%	39	53.4%	
(missing)	(7)	--	(4)	--	(0)	--	
Total	**1,137**		**606**		**73**		

Table 7. 29 Exclusive breastfeeding practice between across obstetric haemorrhage groups

	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+		P
	N	%	N	%	N	%	
No BF/BF & formula milk	532	47.1%	297	49.3%	34	46.6%	0.67
Only BF	598	52.9%	305	50.7%	39	53.4%	
(missing)	(7)	--	(4)	--	(0)	--	
Total	**1,137**		**606**		**73**		

Major obstetric haemorrhage and health service use

Home visits by midwives and health visitors

As Table 7.30 shows, the average numbers of postnatal visits by midwives for women who had no obstetric haemorrhage, who had mild obstetric haemorrhage and who had major obstetric haemorrhage were 2.74 (SD=1.43, 95%CI=2.66 to 2.82), 2.72 (SD=1.37, 95%CI=2.61 to 2.83) and 3.03 (SD=1.40, 95%CI=2.70 to 3.36), respectively. ANOVA showed that these differences were not statistically significant ($F_{2, 1802}$=1.58, P=0.21), indicating that the number of visits by midwives during the 6-8 weeks postpartum period was very similar between the three groups.

The average (mean) numbers of postnatal visits by health visitors for women who had no obstetric haemorrhage, who had mild obstetric haemorrhage and who had major obstetric haemorrhage were 1.33 (SD=0.77, 95%CI=1.28 to 1.37), 1.44 (SD=0.86, 95%CI=1.37 to 1.51) and 1.32 (SD=0.75, 95%CI=1.14 to 1.50),

respectively. ANOVA showed there was a statistically significantly difference in the number of home visits by health visitors across the three obstetric haemorrhage groups ($F_{2,1775}$=3.78,p=0.02), but Tukey HDS Post Hoc test indicated that a statistical difference only existed between the no obstetric haemorrhage group and the mild haemorrhage groups and not the other pairs of groups.

Table 7. 30 The average number of routine home visits by midwives and health visitors across obstetric haemorrhage groups

	No (n=1137)			Mild (n=606)			Major (n=73)			
	EBL<500ml AND no BT			EBL 500≤,<1,500ml OR BT1-3			EBL≥1,500ml OR BT4+			
	Mean	(SD)	95%CI	Mean	(SD)	95%CI	Mean	(SD)	95%CI	P
Midwives	2.74	(1.43)	2.66-2.82	2.72	(1.38)	2.61-2.83	3.03	(1.40)	2.70-3.36	0.21
Health visitors	1.33	(0.77)	1.28-1.37	1.44	(0.86)	1.37-1.51	1.32	(0.75)	1.14-1.50	0.02

Six to eight week postnatal GP check

The proportion of women who visited their GP for the routine six to eight week postnatal check was 68.6% among women with major obstetric haemorrhage, statistically significantly lower than those who had no or mild obstetric haemorrhage (81.6% and 82.4%, respectively) as shown Tables 7.31 and 7.32.

Table 7. 31 Six to eight week postnatal check at GP across obstetric haemorrhage groups

	None		Mild		Major		
	EBL<500ml AND no BT		EBL500≤,< 1500ml OR BT1-3		EBL>=1500ml OR BT4+		
	N	%	N	%	N	%	P
No	204	18.4%	105	17.6%	22	31.4%	0.019
Yes	904	81.6%	490	82.4%	48	68.6%	
(missing)	(29)	--	(11)	--	(3)	--	
Total	**1,137**		**606**		**73**		

Table 7. 32 Bivariate logistic regression: routine visits to GP for six to eight week postnatal check across obstetric haemorrhage groups

Non-routine visits	Frequency	ORs	95%CI	P
No obstetric haemorrhage	1,137	1		
Mild obstetric haemorrhage	606	1.05	0.81-1.37	0.70
Major obstetric haemorrhage	73	0.49	0.29-0.83	0.008
(missing)	(8)	--	--	--
Total	**1,816**			

Non-routine visits to healthcare professionals

In contrast to the lower proportion of visits to their GP for routine six week postnatal check, women with major obstetric haemorrhage reported most frequently non-routine visits to healthcare professionals for themselves during postnatal period (45.1%), compared to women with mild (39.5%) or no obstetric haemorrhage; the overall difference across the three groups was statistically highly significant (P≤0.001) (Table 7.33). To identify where the significant difference existed across the three obstetric haemorrhage groups, logistic regression analysis was conducted which showed there was significant difference both between women with no obstetric haemorrhage and women with mild obstetric haemorrhage, and between women with no obstetric haemorrhage and women with major obstetric haemorrhage (Table 7.34).

Table 7. 33 Non-routine visits to healthcare professionals across obstetric haemorrhage groups

Non-routine visits	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+		P
Mothers							
No	776	69.1%	363	60.5%	39	54.9%	<0.001
Yes	347	30.9%	237	39.5%	32	45.1%	
(missing)	(14)	--	(6)	--	(2)	--	
Babies							
No	568	50.6%	312	52.2%	38	53.5%	0.79
Yes	555	49.4%	288	48.0%	33	46.5%	
(missing)	(14)	--	(6)	--	(2)	--	
Total	**1,137**		**606**		**73**		

Table 7. 34 Bivariate logistic regression – Non-routine visits to healthcare professionals across obstetric haemorrhage groups

Non-routine visits	Frequency	ORs	95%CI	P
No obstetric haemorrhage	1,137	1		
Mild obstetric haemorrhage	606	1.46	1.19-1.80	<0.001
Major obstetric haemorrhage	73	1.84	1.13-2.98	0.014
(missing)	(8)	--	--	--
Total	**1,816**			

Of those women with major obstetric haemorrhage who also visited healthcare professionals for themselves postnatally (n=32), the most commonly visited place was the GP practice (n=22, 68.8%) followed by others (n=8, 25.0%) (Table 7.35). The reasons most frequently reported for visits to healthcare professionals were wound problems (caesarean-section or perineal) followed by problems of breastfeeding. A similar finding was observed for women with mild obstetric haemorrhage who visited their GP most frequently and the most common reasons were again wound problems followed by problems or support for breastfeeding. On the other hand, for women with no obstetric haemorrhage, the most frequent reasons for their visits to healthcare professionals were problems or support for breastfeeding. Regarding visits to healthcare professionals for their babies, there was no statistically significant difference in the proportion across the three categories of obstetric haemorrhages.

Table 7. 35 Place for non-routine visits to healthcare professionals for mothers

Non-routine visits	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+	
GP	269	77.5%	192	81.0%	22	68.8%
Children's centre	55	15.9%	36	15.2%	5	15.6%
Community clinic	60	17.3%	45	19.0%	3	9.4%
Hospital postnatal clinic	80	23.1%	55	23.2%	5	15.6%
Other	84	24.2%	67	28.3%	8	25.5%

Note: Percentage does not add up to 100% because some women had more than one visits to different healthcare professionals.

Hospital readmission

Fisher's exact test showed no statistically significant differences in the hospital readmissions for women across the three obstetric haemorrhage groups. Similarly the Chi-square tests indicated no statistically significant difference in the hospital readmissions for babies across the three obstetric haemorrhage groups. Table 7.36

summarises the results of healthcare use between the three obstetric haemorrhage groups.

Table 7. 36 Hospital readmissions across obstetric haemorrhage groups

Readmission	None EBL<500ml AND no BT		Mild EBL500≤,< 1500ml OR BT1-3		Major EBL>=1500ml OR BT4+		P
Mothers							
No	1,068	94.7%	571	95.0%	70	95.9%	0.98
Yes	60	5.3%	30	5.0%	3	4.1%	
(missing)	(9)	--	(5)	--	(0)	--	
Babies							
No	1,030	91.3%	561	93.3%	66	91.7%	0.33
Yes	98	8.7%	40	6.7%	6	8.3%	
(missing)	(9)	--	(5)	--	(1)	--	
Total	1,137		606		73		

7.2.2 Hypertensive disorders and postnatal health outcomes

Hypertensive disorders and PTSD symptoms (IES)

Difference in the IES scores

The Kruskal-Wallis test, a non-parametric test, was used to compare differences in the IES scores between women in the three hypertensive disorder groups: (i) non-hypertensive disorders, (ii) hypertension/pre-eclampsia (PET) and (iii) severe PET/eclampsia/HELLP syndrome. The decision to use a non-parametric test was made because of the combination of the small number of cases (n=11) in the exposed group (women with severe PET/eclampsia/HELLP) and also because the distribution of the outcome within the group was not normally distributed. The Kruskal-Wallis test compares the '*ranks'* of the groups. The result indicated statistically significant differences in the mean average of total IES scores of the rank across three groups at P=0.002 level.

The post-hoc test was further performed to determine which pairwise comparisons were significant. The group with severe PET/eclampsia/HELLP had the highest

mean value of the ranks (1,382.91), indicating that this group had the most severe PTSD symptoms, followed by the group of hypertension/PET (935.99). Differences were statistically significant between the non-hypertensive disorder group and the severe PET/eclampsia/HELLP group and also between the hypertension/PET group and the group with severe PET/eclampsia/HELLP. The difference was however not statistically significant between the group with non- hypertensive disorder and the group with hypertension/PET.

The Kruskal-Wallis test also showed that there were overall statistical differences between the three groups in the values of the rank of IES intrusion subscale (P=0.007) as well as that of IES-avoidance scales (P=0.001). However, for IES intrusion subscale, the only significant post-hoc result using the Bonferroni test was severe PET/eclampsia/HELLP versus none (P=0.026). Similarly, for IES avoidance scale, severe PET/eclampsia/HELLP had a statistically significant higher value of the rank from the rest of women (non-hypertensive disorder group and hypertension/PET group) as shown in Table 7.37. These tests consistently indicated that women with severe PET/eclampsia/HELLP had more severe intrusion and avoidance symptoms at 6-8 weeks postpartum.

Table 7. 37 Differences in ranks of IES score between hypertensive disorder groups

	P [23]
Total score	***Overall 0.002***
Hypertension/PET vs. Non-hypertensive disorders	0.60
Severe PET/eclampsia/HELLP vs. Non-hypertensive disorders	0.002
Severe PET/eclampsia/HELLP vs. Hypertension/PET	0.013
Intrusion subscale	***Overall 0.007***
Hypertension/PET vs. Non-hypertensive disorders	0.22
Severe PET/eclampsia/HELLP vs. Non-hypertensive disorders	0.026
Severe PET/eclampsia/HELLP vs. Hypertension/PET	0.14
Avoidance subscale	***Overall 0.001***
Hypertension/PET vs. Non-hypertensive disorders	1.0
Severe PET/eclampsia/HELLP vs. Non-hypertensive disorders	0.001
Severe PET/eclampsia/HELLP vs. Hypertension/PET	0.004

Difference in the proportion of the IES score ≥20 across hypertenstive disorder groups

As Table 7.38 shows, the proportion of women who had an IES score of 20 or more on both subscales (intrusion and avoidance) increased as the severity of the hypertensive disorder increased (3.2%, 5.0% and 18.2% for the group of non-hypertensive disorder, hypertension/PET, and severe PET/eclampsia/HELLP, respectively), which was statistically significant (Fisher's exact test, P=0.03) (Logistic regression analysis was not performed to see which pair of groups had a statistically significant difference as the results for severe PET would not be reliable as that group had few cases). There were also statistically significant differences between the three groups in the proportion of women with 20 or more on the IES avoidance subscale. However, with such a small number of women in the severe PET/eclampsia/HELLP group, a statistical difference was not observed on the

[23] The P-value was adjusted for multiple testing The post-hoc tests perform the pairwise comparisons between the groups. There are, therefore, for comparison of three groups three pairs (group 1 vs. group 2, group 1 vs. group 3, group 2 vs. group 3). Assuming the standard significance level of P≤0.05 for determining whether to reject the null hypothesis (of no difference between the groups), if there really were no difference between the three groups one would expect each of these tests to show spurious significance with a probability of 0.05. Therefore (as there are three pairwise tests), one would expect at least one of these three tests to show spurious significance with a probability of nearly 0.15. The post-hoc tests attempt to modify the P-values of the pairwise tests so that overall the probability of spurious significance is 0.05. This is called 'adjusted P-value' in the context of post-hoc tests using the Bonferroni method, which is shown in the last column of the table (information obtained through personal communication with a statistician, Dr Derek Cooper).

intrusion subscale (≥20), although the proportion of women who had subscales scores of 20 or more was the highest among women in the severe PET/eclampsia/HELLP group (6.6%, 6.6%, and 18.2% for the non-hypertensive disorder group, the hypertension/PET group, and the severe PET/eclampsia/HELLP group, respectively).

Table 7. 38 Proportion of PTSD symptoms across hypertensive disorder groups

	None (n=1688)		Hypertension/PET (n=125)		Severe PET/eclampsia/ HELLP (n=11)		
	N	%	N	%	N	%	P
Both subscales (int & avo)							
<20 on at least one subscale	1,581	96.8%	114	95.0%	9	81.8%	0.032
≥20 on both†	53	3.2%	6	5.0%	2	18.2%	
(missing)	(54)	--	(5)	--	(0)	--	
Intrusion subscale							
<20	1,546	93.7%	114	93.4%	9	81.8%	0.22
≥20	104	6.6%	8	6.6%	2	18.2%	
(missing)	(33)	--	(3)	--	(0)	--	
Avoidance subscale							
<20	1,518	92.0%	109	90.8%	4	36.4%	<0.001
≥20	132	8.0%	11	9.2%	7	63.6%	
(missing)	(33)	--	(5)	--	(0)	--	

† Both=Intrusion subscale scores≥20 AND avoidance subscale scores≥20 (therefore scores≥40). int: intrusion; avo: avoidance.

Hypertensive disorders and postnatal depression (EPDS)

A Kruskal-Wallis test indicated that there were no statistically significant differences in median EPDS scores between three different levels of hypertensive disorder groups: non-hypertensive disorder, hypertension/PET, and severe PET/eclampsia/HELLP (P=0.67). Fisher's exact test also showed no statistically significant difference in the proportion of the EPDS score≥13 across the three different level of hypertensive disorder groups (P=0.57), as shown in Table 7.39.

Table 7. 39 Postnatal depression across hypertensive disorder groups

EPDS	None		Hypertension/PET		Severe PET/eclampsia/ HELLP		P
<13	1,420	85.9%	104	86.7%	11	100%	0.57
≥13	234	14.1%	16	13.3%	0	0%	
(missing)	(34)	--	(5)	--	(0)	--	
Total	1,688		125		11		

Hypertensive disorders and general health (SF-12)

A Kruskal-Wallis test indicated that statistical differences in the PHC-12 scores between the three different hypertensive disorder groups were highly significant (P=0.003)[24]. However, the only significant post-hoc result using the Bonferroni test was hypertension vs. no hypertension (P=0.016) as shown in Table 7.40, although the severe PET/eclampsia/HELLP group had the lowest value (rank), indicating the poorest physical health outcomes were in this group. The reason for the non-significance is likely due to the limited statistical power to detect a statistically significant difference with such a small numbers of women with severe PET/eclampsia/HELLP in the study sample.

Table 7. 40 Differences in ranks of IES score between hypertensive disorder groups

	P[25]
PHC-12	***Overall 0.003***
Hypertension/PET vs. Non-hypertensive disorders	0.016
Severe PET/eclampsia/HELLP vs. Non-hypertensive disorders	0.14
Severe PET/eclampsia/HELLP vs. Hypertension/PET	0.64

With regard to MHS-12 scores, no statistically significant difference was observed across the three hypertensive disorder groups (P=0.89), therefore further analysis was not performed.

[24] Results in the text were based on the calculation in which '3: a good bit of the time' was combined with '4: some of the time' in the question "Has your health limited your social activities like visiting friends or close relatives?". The results were the same when compared to the one in which 3: a good bit of the time' was combined with '2: most of the time'.

[25] The P-value was adjusted for multiple testing. The post-hoc tests perform the pairwise comparisons between the groups. There are, therefore, for comparison of three groups three pairs (group 1 vs. group 2, group 1 vs. group 3, group 2 vs. group 3). Assuming the standard significance level of P≤0.05 for determining whether to reject the null hypothesis (of no difference between the groups), if there really were no difference between the three groups one would expect each of these tests to show spurious significance with a probability of 0.05. Therefore (as there are three pairwise tests), one would expect at least one of these three tests to show spurious significance with a probability of nearly 0.15. The post-hoc tests attempt to modify the P-values of the pairwise tests so that overall the probability of spurious significance is 0.05. This is called 'adjusted P-value' in the context of post-hoc tests using the Bonferroni method (information obtained through personal communication with a statistician, Dr Derek Cooper).

Hypertensive disorders and breastfeeding

As Table 7.41 shows, the statistical differences between the three hypertensive disorder groups was highly significant (Fisher's exact test, P<0.001) with the proportion of women who were exclusively breastfeeding at 6-8 weeks postpartum decreasing with a rise of severity of hypertensive disorder (53.3%, 36.0% and 27.3% for the group with none, hypertension/PET and severe PET/eclampsia/HELLP, respectively), while the proportion of women who had never breastfed their babies since their birth increasing with a rise of severity of hypertensive disorder (4.8%, 6.4% and 18.2% for the group with none, hypertension/PET and severe PET/eclampsia/HELLP, respectively).

Table 7. 41 Breastfeeding practice between across obstetric haemorrhage groups

	No		Hypertension/PET		Severe PET/ eclampsia/ HELLP		
	N	%	N	%	N	%	P
Never	81	4.8%	8	6.4%	2	18.2%	<0.001
Stopped breastfeeding	174	10.4%	16	12.8%	3	27.3%	
Breast milk plus formula	525	31.3%	56	44.8%	3	27.3%	
Only breast milk	897	53.5%	45	36.0%	3	27.3%	
(missing)	(11)	--	(0)	--	(0)	--	
Total	**1,688**		**125**		**11**		

Table 7. 42 Exclusive breastfeeding (BF) practice between across obstetric haemorrhage groups

	No		Hypertension/PET		Severe PET/ eclampsia/ HELLP		
	N	%	N	%	N	%	P
No BF/BF & formula milk	780	46.5%	80	64.0%	8	72.7%	<0.001
Only BF	897	53.5%	45	36.0%	3	27.3%	
(missing)	(11)	--	(0)	--	(0)	--	
Total	**1,688**		**125**		**11**		

Hypertensive disorders and health care use

Home visits by midwives and health visitors

A non-parametric test (Kruskal-Wallis test) was again used to ascertain whether there were differences across the three hypertensive disorder groups in terms of the number of home visits by midwives and health visitors. While home visits by midwives was far from significant (P=0.43), home visits by health visitors was almost significant (P=0.054). However, due to the latter non-significant result, pairwise comparisons could not be performed, and it was not possible to know which pair of hypertensive disorder groups had a significant difference.

Six to eight week postnatal GP check

There was no statistically significant difference in the proportion of women who visited their GP for the routine six to eight week postnatal check across the three hypertensive disorder groups (Table 7.43).

Table 7. 43 Six to eight week postnatal check by GP across hypertensive disorder groups

	No		Hypertension/PET		Severe PET/eclampsia/ HELLP		P
No	300	18.2%	32	26.0%	1	9.1%	0.08
Yes	1,347	81.8%	91	74.0%	10	90.9%	
(missing)	(41)	--	(2)	--	(0)	--	
Total	**1,688**		**125**		**11**		

Non-routine visits to healthcare professionals

There were no statistically significant differences in the proportion of visits to healthcare professionals either for themselves or for their babies across the three hypertensive disorder groups (Table 7.44).

Table 7. 44 Non-routine visits to healthcare professionals across hypertensive disorder groups

	No		Hypertension/PET		Severe PET/ eclampsia/ HELLP		
	N	%	N	%	N	%	P
Mothers							
No	1,104	66.2%	74	59.2%	6	66.7%	0.25
Yes	564	33.8%	51	40.8%	3	33.3%	
(missing)	(20)	--	(0)	--	(2)	--	
Babies							
No	848	50.8%	69	55.2%	6	66.7%	0.42
Yes	820	49.2%	56	44.8%	3	33.3%)	
(missing)	(20)	--	(0)	--	(2)	--	
Total	**1,688**		**125**		**11**		

Hospital readmission

A Fisher's exact test showed that the proportion of the hospital readmissions for mother and for baby was not statistically different across the three hypertensive disorder groups Table 7.45).

Table 7. 45 Hospital readmissions across hypertensive disorder groups

	No		Hypertension/PET		Severe PET/ eclampsia/ HELLP		
	N	%	N	%	N	%	P
Mothers							
No	1,591	94.9%	114	92.7%	11	100%	0.45
Yes	85	5.1%	9	7.3%	0	0%	
(missing)	(12)	--	(2)	--	(0)	--	
Babies							
No	1,545	92.1%	109	90.1%	11	100%	0.52
Yes	132	7.9%	12	9.9%	0	0%	
(missing)	(11)	--	(4)	--	(0)	--	
Total	**1,688**		**125**		**11**		

7.2.3 High dependency unit (HDU) admission and postnatal outcomes

HDU admission and PTSD symptoms (IES)

Difference in the mean IES scores (HDU admission vs. non HDU admission)

The mean IES total score among women admitted to the HDU (n=102; mean=17.21; SD=16.63) and those who were not (n=1,663; mean=10.76; SD=13.72) differed significantly (t=4.55; P<0.001; mean difference=6.45; 95%CI= 9.23 to 3.67), indicating that women who were admitted to the HDU had more severe PTSD symptoms at 6-8 weeks. In addition, the mean score of the IES avoidance subscale was higher in women who were admitted to the HDU (n=102; mean=8.39; SD=9.36) than in women who were not (n=1,679; mean=5.18; SD=7.64); a statistically significant result (P<0.001), indicating that women with HDU admission had more severe avoidance symptoms compared to those who did not enter the HDU (t=4.06, P<0.001, mean difference=3.21, 95%CI=4.76 to 1.66). Similarly, the mean scores of the IES intrusion subscale for women with the HDU admission (n=103) was 8.76 (SD=8.66), while the corresponding figure for women with no HDU admission (n=1,680) was 5.61, (SD=7.20) which was statistically different at P<0.001 level (t=4.25, P=0.001, mean difference=3.15, 95%CI=4.60 to 1.70).

Table 7. 46 IES mean scores (PTSD symptoms) between women with and without HDU admission

	No HDU admission (n=1,721)		HDU admission (n=103)		P
	Mean	(SD)	Mean	(SD)	
Total mean	10.76	(13.72)	17.21	(16.63)	<0.001
Intrusion	5.18	(7.64)	8.39	(9.34)	<0.001
Avoidance	4.69	(7.35)	6.16	(8.20)	<0.001

Difference in the proportion of IES scores ≥20 (HDU admission vs. non HDU admission)

A Fisher's exact test showed that the proportion of women scoring 20 or more on both the IES subscales was higher in women who were admitted to the HDU admission (7.8%) than women who were not (3.2%) which was statistically significantly different (P=0.02). A Chi-square test also showed that the proportion of women with 20 or more on the IES avoidance sub score was significantly higher in women with HDU admission (19.6%) than in women without (7.7%), showing women admitted to the HDU having suffered more from a clinically significant level of avoidance symptoms (P<0.001). However, difference in the proportions in the two groups with an IES intrusion sub score of 20 or more were not statistically significance (6.1% of women with the HDU admission and 10.7% of women without; P=0.09) as shown in Table 7.47.

Table 7. 47 Proportion of PTSD symptoms between women with and without HDU admission

	No HDU admission (n=1,721)		HDU admission (n=103)		P
	N	%	N	%	
Both subscales (int & avo)					
<20 on at least one subscale	1,610	96.8%	94	92.2%	0.02
≥20 on both†	53	3.2%	8	7.8%	
(missing)	(58)	--	(1)	--	
Intrusion subscale					
<20	1,557	93.9%	92	89.3%	0.09
≥20	103	6.1%	11	10.7%	
(missing)	(41)	--	(0)	--	
Avoidance subscale					
<20	1,549	92.3%	82	80.4%	<0.001
≥20	130	7.7%	20	19.6%	
(missing)	(42)	--	(1)	--	

† Both=Intrusion subscale scores≥20 AND avoidance subscale scores≥20 (therefore scores≥40). int: intrusion; avo: avoidance.

HDU admission and postnatal depression (EPDS)

In contrast to PTSD symptoms, depressive symptoms measured by the mean scores of the EPDS among women with HDU admission (mean=7.08; SD=4.94) were similar to those of women without HDU admission (mean=6.75; SD=5.11), which was not statistically different (t=0.63; P=0.53; mean difference=0.33; 95%CI= - 0.70 to 1.36) (Table 7.48).

Table 7. 48 EPDS total mean scores between women with and without HDU admission

	No HDU admission (n=1,721)		HDU admission (n=103)		
	Mean	SD	Mean	SD	P
EPDS total	6.75	5.10	7.08	4.94	0.52

Similarly, the proportions of women with an EPDS score of 13 or more (indicating risk of postnatal depression) were not statistically significantly different (Chi-square test, P=0.77) between women with (13.0%) and without HDU admission (14.1%) (Table 7.49).

Table 7. 49 Postnatal depression between women with and with and without HDU admission

	No HDU admission		HDU admission		
EPDS	Frequency	Percentage	Frequency	Percentage	P
<13	1,448	85.9%	87	87.0%	0.77
≥13	237	14.1%	13	13.0%	
(missing)	(36)	--	(3)	--	
Total	**1,721**		**103**		

HDU admission and general health (SF-12)

A T-test showed that the mean scores of physical health components in the SF-12 (PHC-12) were significantly lower among women who were admitted to the HDU (mean=43.99; SD=9.57) when compared with women who were not admitted to the HDU (mean=49.09; SD=9.05), indicating women who were admitted to the HDU had poorer physical health at 6-8 weeks postpartum (t=- 5.18; P<0.001; mean difference=- 5.10, 95%CI=- 7.02 to - 3.17).

On the other hand, the mean scores of mental health components (MHC-12) in women with HDU admission (mean=48.71; SD=8.92) and women without HDU admission (mean=48.50; SD=9.67) were not statistically different (t=0.54; P=0.84; mean difference=0.21; 95%CI= - 1.84 to 2.25) (Table 7.50).

Table 7. 50 Difference in general health between women with and without HDU admission

SF-12 (mean)	No HDU admission (n=1,721)		HDU admission (n=103)		
	Mean	SD	Mean	SD	P
PHC-12†	49.09	9.05	43.99	9.57	<0.001
(PHC-12)‡	49.04	9.07	43.95	9.59	<0.001
MHC-12†	48.50	9.67	48.71	8.92	0.84
(MHC-12)‡	48.31	9.84	48.56	8.96	0.82

† Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '4: some of the time'

‡ Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '2: most of the time'.

HDU admission and breastfeeding practice

Regarding breastfeeding practice at 6-8 weeks, there was no statistical difference between women with and without HDU admission. The result was the same when breastfeeding practice was categorised into four groups (Table 7.51) or treated as binary (Table 7.52). However, it is worth noting that although not statistically significant, a smaller proportion of the HDU admissions were for exclusively breastfeeding women.

Table 7. 51 Breastfeeding practice between women with and without HDU admission

	No HDU admission		HDU admission		P
Breastfeeding	N	%	N	%	
Never	86	5.0%	5	4.9%	0.43
Stopped breastfeeding	181	10.6%	12	11.7%	
Breast milk plus formula	544	31.8%	40	38.8%	
Only breast milk	899	52.6%	46	44.7%	
(missing)	(11)	--	(0)	--	
Total	1,721		103		

Table 7. 52 Exclusive breastfeeding (BF) practice between women with and without HDU admission

	No HDU admission		HDU admission		P
Breastfeeding	N	%	N	%	
No BF/BF & formula milk	811	47.4%	57	55.3%	0.12
Only BF	899	52.6%	46	44.7%	
(missing)	(11)	-	(0)	--	
Total	**1,721**		**103**		

HDU admission and health service use

Home visits by midwives and health visitors

As shown in Table 7.53, the average number of visits by midwives during the 6-8 weeks postpartum period for women who were admitted to an HDU was 2.77 (SD=1.57), while the corresponding figure for women without HDU admission was 2.74 (SD=1.40); the difference was not statistically significant (t=0.41; P=0.82; mean difference= 0.032; 95% CI= - 0.25 to 0.32). The difference in the number of visits by health visitors was, however, statistically significant between the two groups (t=2.42;

P=0.015; mean difference= 0.20; 95% CI= 0.04 to 0.36); the average number of visits by health visitors during the 6-8 weeks postpartum period was slightly higher in women with HDU admission (mean=1.55, SD=1.03) than women without HDU admission (mean=1.36, SD=0.79).

Table 7. 53 Average number (mean) of routine home visits by midwives and health visitors (HDU admission)

	No HDU admission (n=1,721)		HDU admission (n=103)		
	mean	SD	mean	SD	P
Midwives	2.74	1.40	2.77	1.57	0.82
Health visitors	1.36	0.79	1.55	1.03	0.015

Six to eight week GP postnatal check

Regarding the routine six to eight week postnatal check by the GP, there was no statistically significant difference between women with and without HDU admission, as shown in the Table 7.54.

Table 7. 54 Six to eight week postnatal check by the GP (HDU admission)

	No HDU admission		HDU admission		
	N	%	N	%	P
6 week postnatal check					
No	316	18.8%	17	16.8%	0.62
Yes	1,364	81.2%	84	83.2%	
(missing)	(41)	--	(2)	--	
Total	**1,721**		**103**		

Non-routine visits to healthcare professionals

As shown in Table 7.55, there was also no statistically significant difference between women with and without HDU admission regarding their non-routine visits to healthcare professionals either for themselves (P=0.07) or for their babies (P=0.64).

Table 7. 55 Non-routine visits to healthcare professionals between women with and without HDU admission

Non-routine visits	No HDU admission N	%	HDU admission N	%	P
Mothers					
No	1,126	66.2%	58	57.4%	0.07
Yes	575	33.8%	43	42.6%	
(missing)	(20)	--	(2)	--	
Babies					
No	869	51.1%	54	53.5%	0.64
Yes	832	48.9%	47	46.5%	
(missing)	(20)	--	(2)	--	
Total	**1,721**		**103**		

Hospital readmission

There were no significant differences between the two groups (women with and without HDU admission) in the proportion of the hospital readmission either for mothers or babies. Table 7.56 presents the bivariate relationship of the HDU admission and postnatal outcomes.

Table 7. 56 Hospital readmissions between women with and without HDU admission

Hospital readmission	No HDU admission N	%	HDU admission N	%	P
Mothers					
No	1,618	94.7%	98	96.1%	0.65
Yes	90	5.3%	4	3.9%	
(missing)	(13)	--	(1)	--	
Babies					
No	1,573	92.1%	92	90.2%	0.57
Yes	134	7.9%	10	9.8%	
(missing)	(14)	--	(1)	--	
Total	**1,721**		**103**		

7.2.4 All severe maternal morbidity (SMM) cases and postnatal outcomes

Finally, women who experienced any of the three indicators of severe maternal morbidity: (i) major obstetric haemorrhage (ii) severe PET/eclampsia/HELLP or (iii) those who were admitted to the HDU immediately after giving birth, were put in a category for all types of severe maternal morbidity (SMM) and the rest of women

were put in a no SMM category. Differences in postnatal outcomes between these two groups were compared.

All SMM cases and PTSD symptoms (IES)

Both severity of PTSD symptoms and the propoportion of clinically significant level of PTSD symptoms measured by the IES consistently showed a statistically significant difference between women with and without severe maternal morbidity, as described below.

Difference in the mean IES scores (all SMM cases vs. no SMM)

The mean total score of the IES for women with severe maternal morbidity was 17.79 (SD=16.33), while the corresponding figure for women without severe maternal morbidity was 10.54 (SD=13.61), a statistically significant difference (t=6.00; P<0.001; mean difference=7.23; 95%CI=4.88 to 9.62), indicating women with severe maternal morbidity had more severe PTSD symptoms at 6-8 weeks postpartum. Similary, the mean score for the intrusion scale was statistically significantly higher in women with severe maternal morbidity (mean=9.05; SD=8.41) when compared to women without severe maternal morbidity (mean=5.50; SD=7.16) (t=5.63; P<0.001; mean difference=3.55; 95%CI= 2.31 to 4.78). The mean score of avoidance scales among women who had severe maternal morbidity (mean=8.71; SD=9.35) and those who did not (mean=5.07; SD=7.57) also differed significantly (t=5.41; P<0.001; mean difference=3.64; 95%CI=2.32 to 4.96).

Table 7. 57 IES mean scores (PTSD symptoms) between women with and without SMM

	No SMM (n=1,677)		All SMM cases (n=147)		
	Mean	(SD)	Mean	(SD)	P
Total mean	10.54	(13.61)	17.79	(16.33)	<0.001
Intrusion	5.50	(7.16)	9.05	(8.41)	<0.001
Avoidance	5.07	(7.57)	8.71	(9.35)	<0.001

Difference in the proportion of the IES≥20 (all SMM cases vs. no SMM)

There was a highly significant difference between women with and without SMM in the proportion of women who had a clinically significant level of both intrusion and avoidance subscales (≥20 on both subscales) (8.4% for SMM group, 3.0% for non-SMM group, P=0.001).

Similarly, the proportion of women with 20 or more on the IES intrusion subscale was 11.7% in women with SMM, while the corresponding figure was 5.9% in women without SMM; the difference was statistically significant (P<0.01). The proportion of the women who had 20 or more on the IES avoidance subscale was also significanly higher in all the SMM cases group when compared to no SMM group (21.0% for SMM group and 7.3% for non-SMM group, P<0.001).

Table 7. 58 Proportion of PTSD symptoms between women with and without SMM

	No SMM		All SMM cases		
	N	%	N	%	P
Both subscales (int & avo)					
<20 on at least one subscale	1,573	97.0%	131	91.6%	0.001
≥20 on both†	49	3.0%	12	8.4%	
(missing)	(55)	--	(4)	--	
Intrusion subscale					
<20	1,541	94.1%	128	88.3%	<0.01
≥20	97	5.9%	17	11.7%	
(missing)	(39)	--	(2)	--	
Avoidance subscale					
<20	1,518	92.7%	113	79.0%	<0.001
≥20	120	7.3%	30	21.0%	
(missing)	(39)	--	(4)	--	
Total	**1,677**		**147**		

† Both=Intrusion subscale scores≥20 AND avoidance subscale scores≥20 (therefore scores≥40), int=intrusion, avo=avoidance

All SMM cases and postnatal depression (EPDS)

Regarding postnatal depression, there was no statistically significant difference in mean scores of EPDS between women with and without SMM (Table 7.59) as well as in the proportion of women having EPDS≥13 between the two groups (Table 7.60).

Table 7. 59 EPDS total mean scores between women with and without SMM

	No SMM (n=1,677)		All SMM cases (n=147)		
	Mean	SD	Mean	SD	P
EPDS total	6.72	5.11	7.30	4.90	0.19

Table 7. 60 Postnatal depression between women with and without SMM

	No SMM		All SMM cases		
EPDS	Frequency	Percentage	Frequency	Percentage	P
<13	1,412	86.0%	123	85.4%	0.90
≥13	229	14.0%	21	14.6%	
(missing)	(36)	--	(3)	--	
Total	**1,677**		**147**		

All SMM cases and general health (SF-12)

With regard to women's general health, the mean scores of PHC-12 among the SMM group (n=133; mean=44.58; SD=8.99) differed significantly from the non-SMM group (n=1,571; mean=49.18; SD=9.07), indicating women who experienced SMM had poorer physical health outcomes at 6-8 weeks postpartum (t=5.61; P<0.001; mean difference=-4.60, 95%CI=-6.20 to -2.99). There was no statistical difference in the MHC-12 scores between women with and without SMM, indicating mental health status measured by SF-12 was similar between two groups (P=0.22).

Table 7. 61 Difference in general health between women with and without SMM

SF-12 (mean)	No SMM case (n=1,677)		All SMM cases (n=147)		P
	mean	SD	mean	SD	
PHC-12†	49.18	9.07	44.58	8.99	<0.001
(PHC-12)‡	49.13	9.12	44.53	9.02	<0.001
MHC-12†	48.59	9.67	47.53	9.11	0.22
(MHC-12)‡	48.41	9.84	47.53	9.27	0.22

† Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '4: some of the time'

‡ Mean scores of PHC-12 and the MHC-12 summary scales obtained with a calculation in which an answering option '3: a good bit of the time' to the question "Has your health limited your social activities like visiting friends or close relatives?" was combined with '2: most of the time'.

All SMM cases and breastfeeding practice

There were no statistically significant differences in breastfeeding practice at 6-8 weeks postpartum between women with and without SMM, when breastfeeding practice was categorised into four groups as shown in Table 7.62. Similarly, difference in the proportion of women who were exclusively breastfeeding their babies was not statistically significant (P=0.14), but the proportion was smaller for women with SMM (46.3%) compared to women without SMM (52.6%) (Table 7.63)

Table 7. 62 Difference in breastfeeding practice between women with and without SMM

	No SMM cases		All SMM cases		P
Breastfeeding	N	%	N	%	
Never	80	4.8%	11	7.5%	0.33
Stopped breastfeeding	176	10.6%	17	11.6%	
Breast milk plus formula	533	32.0%	51	34.7%	
Only breast milk	877	52.6%	68	46.3%	
(missing)	(11)	--	(0)	--	
Total	**1,677**		**147**		

Table 7. 63 Exclusive breastfeeding (BF) practice between women with and without SMM

	No SMM cases		All SMM cases		P
Breastfeeding	N	%	N	%	
No BF/BF & formula milk	789	47.4%	79	53.7%	0.14
Only BF	877	52.6%	68	46.3%	
(missing)	(11)	--	(0)	--	
Total	**1,677**		**147**		

All SMM cases and health care use

Home visits by midwives and health visitors

The average number of home visits by midwives during the 6-8 weeks postpartum period was 2.88 (SD=1.49) and 2.73 (SD=1.40) for women with SMM and those with and without SMM, respectively, indicating there was no statistical difference between two groups (P=0.21). Similarly, the average number of home visits by health visitors during the same period was similar between women with and without SMM, being 1.46 (SD=0.94) and 1.36 (SD=0.79), respectively (P=0.14).

Table 7. 64 The average number (mean) of routine home visits by midwives and health visitors between women with and without SMM

	No SMM cases (n=1,677)		All SMM cases (n=147)		
	mean	SD	mean	SD	P
Midwives	2.73	1.40	2.88	1.49	0.21
Health visitors	1.36	0.79	1.46	0.94	0.14

Six to eight week postnatal check by GP

Regarding the routine six to eight week postnatal check by the GP, no statistically significant difference was found between women who experienced any types of SMM and those who did not (Table 7.65).

Table 7. 65 Six to eight week postnatal check by GP for women with and without SMM

	No SMM cases		All SMM cases		
6 – 8 week postnatal check	N	%	N	%	P
No	301	18.4%	32	22.2%	0.26
Yes	1,336	81.6%	112	77.8%	
(missing)	(40)	--	(3)	--	
Total	**1,677**		**147**		

Non-routine visits to healthcare professionals

Regarding non-routine visits to healthcare professionals, women who experienced any type of SMM had a statistically significantly higher number of visits for themselves, compared to women without SMM (P=0.017) (Table 7.66). The most common place women attended was their GP practice (Table 7.67) and the most common reasons for the visits were wound problems and problems or support for breastfeeding. The proportion of visits to healthcare professional for their babies was, however, similar between the two groups, which was not statistically significantly different.

Table 7. 66 Non-routine visits to healthcare professionals between women with and without SMM

Non-routine visits	No SMM cases N	%	All SMM cases N	%	P
Mothers					
No	1,103	66.5%	81	56.6%	0.017
Yes	556	33.5%	62	43.4%	
(missing)	(18)	--	(4)	--	
Babies					
No	850	51.2%	73	51.0%	0.97
Yes	809	48.8%	70	49.0%	
(missing)	(18)	--	(4)	--	
Total	**1,677**		**147**		

Table 7. 67 Place for non-routine visits to healthcare professionals

	No SMM cases N	%	All SMM cases N	%
GP	442	79.5%	43	69.4%
Children's centre	87	15.6%	9	14.5%
Community clinic	100	18.0%	8	12.9%
Hospital postnatal clinic	128	23.0%	12	19.4%
Other	141	25.4%	18	29.0%

Note: Percentage does not add up to 100% because some women had more than one visits to different healthcare professionals.

Hospital readmission

There were no statistically significant differences in rates of hospital readmission for mother and baby between women with and without SMM (Table 7.68).

Table 7. 68 Hospital readmissions between women with and without SMM

Readmission	No SMM cases N	%	All SMM cases N	%	P
Mothers					
No	1,576	94.7%	140	96.9%	0.57
Yes	88	5.3%	6	4.1%	
(missing)	(13)	--	(1)	--	
Babies					
No	1,535	92.2%	92	89.7%	0.34
Yes	129	7.8%	10	10.3%	
(missing)	(13)	--	(2)	--	
Total	**1,677**		**147**		

7.2.5 Summary

The analysis consistently showed that clinically significant level of PTSD symptoms (intrusion and/or avoidance measured with IES) at 6-8 weeks postpartum were more frequent and severe in women who experienced SMM measured with three indicators: major obstetric haemorrhage; severe PET/eclampsia/HELLP; and/or HDU admission (women who had any of these condition was considered as the fourth group for analysis), compared to women who did not experience SMM; all differences were statistically significant except for intrusion symptoms where there was no statistically significant difference across hypertensive disorder groups. This may be due to a lack of statistical power to detect the difference (small number of cases of severe PET/eclampsia/HELLP) since the proportion of clinically significant level of intrusion symptoms were almost three times higher in women with severe PET/eclampsia/HELLP (18.2%) than the rest of hypertensive disorder groups (hypertension/pet or none) (6.6%).

There were no statistically significant differences between groups in frequency or severity of postnatal depression (measured with EPDS) and general mental health status (measured with SF-12). The only exception was that women who had major obstetric haemorrhage experienced significantly lower mental health status (in SF-12) at 6-8 weeks postpartum when compared to women without obstetric haemorrhage.

Physical health status (as measured with the SF-12) was significantly lower among women who experienced major obstetric haermorrhage, HDU admission and all severe maternal morbidity cases, but not for the group of women who had just severe PET/eclampsia/HELLP. However, this may be again due to a lack of statistical power with small number of cases of severe PET/eclampsia/HELLP as

there was a clear trend showing the lower PHC-12 score among severe PET/eclampsia/HELLP groups when compared to the rest of hypertensive disorder groups.

There were no statistical differences in breastfeeding practice at 6-8 weeks postpartum between women with and without major obstetric haemorrhage, between women with and without HDU and between women with and without all SMM cases. However, there was an overall significant difference across the three hypertensive disorder groups, indicating the possibility of a lower proportion of exclusive breastfeeding among women with more severe cases of hypertensive disorders.

Regarding health service use, women with SMM (major obstetric haemorrhage; severe PET/eclampsia/HELLP; HDU admission, and all SMM cases) had more home visits by health visitors during the postnatal period compared to women who did not experience SMM; differences were statistically significant or almost significant. Women with major obstetric haemorrhage were significantly more likely to make a non-routine visit to healthcare professionals for themselves compared to women with no obstetric haemorrhage, but not for their babies. They were however less likely to have a routine six to eight-week postnatal check with their GP. Healthcare use as measured by home visits by midwives as well as hospital readmission was also similar between women with and without SMM.

7.3 Chapter summary

This chapter presented postnatal PTSD symptoms and other physical and psychological outcomes at 6-8 weeks postpartum (objective 1) and assessed

whether there were differences in postnatal outcomes between women who had a SMM and those who did not, using bivariate analysis (objective 2). The bivariate analysis showed that women who experienced SMM experienced PTSD symptoms (primary outcome) significantly more frequently, and of greater severity as well as having significantly lower physical health status when compared to women without SMM. However the results in this chapter do not account for any difference in characteristics between women in the exposure and non-exposure groups. The next chapter addresses the relationship between SMM and PTSD symptoms adjusting for potential confounders and taking into account other factors, which might affect the relationship between them.

Chapter 8

Relationship between severe maternal morbidity and PTSD symptoms

The aim of this chapter is to address the third objective of this thesis which is to examine the relationship between severe maternal morbidity (SMM) and posttraumatic stress disorder (PTSD) symptoms at 6 – 8 weeks postpartum taking into account factors that may influence the relationship. The first section examines the relationship between SMM and PTSD symptoms, adjusting for women's baseline characteristics (age, parity, ethnicity, Index Multiple Deprivation (IMD), education qualification, body mass index (BMI) and mental health history). The next section addresses whether the relationship between SMM and PTSD symptoms is mediated by women's perceived control during labour and birth, poor neonatal outcomes, obstetric intervention and/or place of birth. The final section presents the relationship between SMM and PTSD symptoms, taking into account postnatal factors (social support as measured by perceived social support and women's living arrangements, and other perceived stress events).

Exposure and outcome variables

For the purpose of analysis, the variable 'all SMM cases' were selected as the exposure variable. As described in earlier chapters, this is a dichotomous variable: SMM group (i.e. women who had at least one condition of SMM defined as major obstetric haemorrhage, severe pre-eclampsia/eclampsia, HELLP syndrome, or HDU/ICU admission, n=147) or non-SMM group (n=1677). Since the number of cases in the SMM group is larger than that in the individual conditions of SMM, this could ensure the statistical power to detect the differences in health outcomes

between women with and without SMM. Because the primary objective of the current study was to examine the association between SMM and PTSD symptoms, the dichotomous exposure was considered to provide clinically more relevant information (see Chapter 5 - section 5.13.3, for more information why a dichotomous exposure was selected, instead of continuous exposure).

For the outcomes, three indicators of PTSD symptoms; 1) intrusion; 2) avoidance and 3) both intrusion and avoidance symptoms, measured with the Impact of Event Scale (IES), were used. These outcomes were also treated as dichotomous variables to distinguish a clinically significant level of distress symptoms from those of a normal psychological reaction to a stressful event, as recommended by the developer (Horowitz 1982). Using a cut-off suggested by Horowitz (1982), a clinically significant level of intrusion symptoms was defined as a score of 20 or more on the IES intrusion subscale (n=114, IES total score: mean=43.44, range from 20 to 69), while avoidance symptoms were defined as a score of 20 or more on the IES avoidance subscale (n=150, IES total score: mean=42.56, range from 25 to 69). The higher threshold of PTSD symptoms was also included in the outcome variables which were defined as a score of 20 or more on *both* IES intrusion *and* avoidance subscales (n=61, IES total score: mean=50.80, range from 41 to 69) to describe very severe cases of PTSD symptoms, although numbers were overlapping with other indicators (ie. the group of women with intrusion symptoms included women who had both symptoms, and the group of women with avoidance symptom also included women with both symptoms) (Figure 5.1, p.203). Measuring these three outcomes were considered to be important because, firstly, individuals who suffer from PTSD are unlikely to experience one specific symptom but could fluctuate across several at the same time or over a period of time. Secondly, earlier studies on PTSD symptoms in postnatal population (Ayers 1999) indicated that

predictors or contributing factors of intrusion and avoidance symptoms were not necessarily the same. It is possibly because individuals or a social community where an individual belongs, have different coping or management strategies as well as different resources to adopt a stressful event (Rosen et al. 2010).

8.1 Relationship between SMM and PTSD symptoms adjusting for women's baseline characteristics

Women's baseline characteristics were considered to be potential confounders as described in Chapter 5 (see section 5.5.4.1 for rationale and 5.15.3 for analysis). "For a variable to be a confounder, the variable must be associated with the risk factor and causally related to the outcome" (Katz 2006a, p.6). To identify variables which were statistically operating as confounders, the bivariate relationship of each variable of women's baseline characteristics were first examined with severe maternal morbidity and next with PTSD symptoms. A series of multivariable logistic regression models were then developed to examine the relationship between SMM and PTSD symptoms adjusting for women's baseline characteristics.

8.1.1 Bivariate logistic regression

8.1.1.1 Women's baseline characteristics and SMM

Socio-demographic characteristics and SMM

The socio-demographic characteristics of women included age, parity, IMD, ethnicity and education qualification. The relationship between age (as a continuous variable) and SMM was found to be highly statistically significant (p=0.001). For each year increase in a woman's age at delivery, the odds of having SMM increased by 6% (OR=1.06, 95%CI=1.03 - 1.10).

Parity was not significantly associated with SMM (p=0.058) when it was treated as a dichotomous variable (primiparous vs. multiparous). Treating parity as a four-categorical variable; '0', '1', '2' or '3 or more', logistic regression again showed no significant difference.

The odds of having SMM were broadly similar across the five Index of Multiple Deprivation (IMD) groups. Statistically significant differences were not observed in any group when compared to women living in the most deprived area (reference group). There was also no evidence of the effect of ethnicity or women's education qualification on the risk of having SMM.

Pre-existing health conditions and SMM

Women's pre-existing health conditions considered to be important potential confounders were BMI and mental health history. Bivariable logistic regression, however, showed that neither pre-pregnancy BMI (continuous numeric variable) (p=0.42) nor mental health history (yes vs. no) (p=0.22) were significantly associated with SMM. When BMI was treated as a categorical variable ('<18.5', '18.5-24.9', '25-29.9' and '30+'), the overall picture again showed no statistical difference in odds of having SMM between four groups. Table 8.1 summarises the results.

Table 8. 1 Bivariate association between women's baseline characteristics and SMM

	Frequency	ORs	95%CI	P
Age at delivery				
Continuous, unit=year	1824	1.06	1.03 to 1.10	**0.001**
(missing)	(0)	--	--	--
Age-group				***Overall: 0.01***
Under 20	21	2.03	0.39-10.50	0.40
20 - 24	142	1	--	--
25 - 29	328	0.92	0.37-2.32	0.87
30 - 34	717	1.67	0.74-3.73	0.22
35 - 39	491	2.09	0.92-4.73	0.08
40 +	125	3.24	1.31-8.05	0.01
(missing)	(0)	--	--	--
Parity				
Primiparity	1184	1		--
Multiparity	640	0.70	0.48-1.01	**0.058**
(missing)	(0)	--	--	--
Ethnic groups				***Overall: 0.81***
White	1103	1		
Black	432	0.90	0.59-1.36	0.61
Asian	158	0.97	0.53-1.79	0.93
Mixed/Other	131	0.71	0.34-1.49	0.71
(missing)	(0)	--	--	--
Women's education				***Overall: 0.46***
None	86	1		
GCSE	207	0.62	0.26-1.49	0.29
A-level	271	0.57	0.25-1.34	0.20
Degree and above	1227	0.79	0.39-1.63	0.53
(missing)	(33)	--	--	--
Deprivation quintiles (IMD)				***Overall: 0.13***
Most	520	1		--
Second	822	1.49	0.99-2.26	0.06
Third	291	0.91	0.51-1.64	0.76
Fourth	125	0.82	0.36-1.90	0.65
Least	47	1.65	0.61-4.43	0.32
(missing)	(19)	--	--	--
BMI				
Continuous, unit=1 kg/m^2	1777	1.01	0.98-1.05	**0.42**
(missing)	(47)	--	--	--
Mental health history				
No	1725	1		
Yes	72	0.49	0.15-1.56	**0.22**
(missing)	(27)	--	--	--
Total	**1824**			

Note: Reference groups were selected considering the sample size (the largest sample size) in the subgroups or the most (or the least) risk groups based on expectation.

8.1.1.2 Women's baseline characteristics and PTSD symptoms

This section presents the results of the bivariate relationships between women's baseline characteristics and three indicators of PTSD symptoms (intrusion, avoidance and both intrusion and avoidance).

Socio-demographic characteristics and PTSD symptoms

Logistic regression showed that age was not significantly associated with any of the selected indicators of PTSD symptoms: intrusion (≥20 on IES intrusion subscale, p=0.53), avoidance (≥20 on IES avoidance subscale, p=0.90) or both intrusion and avoidance (≥20 on both IES intrusion and avoidance subscales, p=0.39). Parity was also not significantly associated with any of the PTSD symptoms: intrusion (p=0.68), avoidance (p=0.49) or both subscales (p=0.94).

There was no significant association between educational qualification and PTSD symptoms with ≥20 on both IES subscales (p=0.14). Similarly, there was no significant association between educational qualification level and intrusion (p=0.42). However, there was a significant relationship between women's educational qualification level and avoidance symptoms (p=0.002), indicating that women with A-levels or with a degree or higher qualification had significantly lower odds of having IES≥20 on the avoidance subscale compared to women with no educational qualification.

Logistic regression also showed statistically significantly higher odds of having PTSD symptoms among Black women (p=0.001 for intrusion, p<0.001 for avoidance and p=0.03 for both subscales) and minority ethnic groups, such as

mixed race minorities (p=0.002 for intrusion, p=0.07 for avoidance and p<0.001 for both subscales), when compared to White women.

The IMD was not significantly associated with any of the selected indicators of PTSD symptoms (p=0.08 for intrusion, p=0.24 for avoidance, and p=0.40 for both intrusion and avoidance subscales).

Pre-existing health conditions and PTSD symptoms

There was a significant effect of BMI (continuous numeric variable) on all three indicators of PTSD symptoms (intrusion, avoidance and both subscales). For example, for each unit of BMI, the odds of having IES≥20 on both subscales increased by approximately 5% (i.e. 1.05 times the previous odds), which was statistically significant (p=0.02).

There was no evidence of the significant effect of previous mental health history on the risk of having any of the three indicators of PTSD symptoms. Tables 8.2 to 8.4 show the results of bivariate analysis of the association between women's baseline characteristics and PTSD symptoms.

In summary, bivariate analysis shows that none of women's baseline characteristics had a significant relationship with both severe maternal morbidity and PTSD symptoms, indicating they were not statistically acting as confounders.

Table 8. 2 Bivariate association between women's baseline characteristics and ≥20 on intrusion subscale of the IES

	Frequency	ORs	95%CI	P
Age at delivery				
Continuous, unit=year	1783	1.01	0.98 to 1.05	0.53
(missing)	(41)			
Age-group				***Overall: 0.68***
Under 20	19	1.70	0.34-8.53	0.52
20-24	139	1		
25-29	318	0.92	0.41-2.08	0.84
30-34	701	0.92	0.44-1.94	0.83
35-39	483	0.96	0.44-2.07	0.91
40 +	123	1.56	0.63-3.84	0.33
(missing)	(41)	--		--
Parity				
Primiparity	1159	1		
Multiparity	624	0.96	0.65-1.44	0.86
(missing)	(41)	--	--	--
Ethnic groups				***Overall: 0.001***
White	1086	1		
Black	417	2.07	1.35-3.17	0.001
Asian	151	0.81	0.34-1.91	0.63
Mixed/Other	129	2.57	1.40-4.70	0.002
(missing)	(41)	--	--	--
Women's education				***Overall: 0.42***
None	84	1		
GCSE	201	0.48	0.19-1.21	0.12
A-level	262	0.54	0.23-1.28	0.16
Degree and above	1211	0.57	0.28-1.19	0.14
(missing)	(66)	--	--	--
Deprivation quintiles (IMD)				***Overall: 0.08***
Most	505	1		
Second	807	0.97	0.64-1.48	0.89
Third	285	0.54	0.28-1.05	0.07
Fourth	120	0.32	0.10-1.04	0.06
Least	47	0.27	0.04-1.99	0.20
(missing)	(60)	--	--	--
BMI				
Continuous, unit=1 kg/m^2	1738	1.06	1.02-1.09	0.001
(missing)	(86)	--	--	--
Mental health history				
No	1688	1		
Yes	71	1.63	0.73-3.65	0.23
(missing)	(65)	--	--	--
Total	**1824**			

Note: Reference groups were selected considering the sample size (the largest sample size) in the subgroups or the most (or the least) risk groups based on expectation.

Table 8. 3 Bivariate association between women's baseline characteristics and ≥20 on avoidance subscale of the IES

	Frequency	ORs	95%CI	P
Age at delivery				
Continuous, unit=year	1781	1.00	0.97 to 1.04	0.90
(missing)	(43)			
Age-group				***Overall: 0.79***
Under 20	20	0.54	0.07-4.39	0.64
20-24	135	1		
25-29	319	1.14	0.57-2.30	0.71
30-34	703	0.84	0.43-2.62	0.59
35-39	481	0.93	0.47-1.83	0.83
40 +	123	1.11	0.48-2.57	0.81
(missing)	(43)	--		--
Parity				
Primiparity	1162	1		
Multiparity	619	1.13	0.80-1.60	0.49
(missing)	(43)	--	--	--
Ethnic groups				***Overall: 0.001***
White	1087	1		
Black	413	2.08	1.43-3.02	<0.001
Asian	154	1.08	0.56-2.09	0.81
Mixed/Other	127	1.75	0.95-3.20	0.07
(missing)	(43)	--	--	--
Women's education				***Overall: 0.002***
None	80	1		
GCSE	201	0.73	0.35-1.51	0.40
A-level	259	0.27	0.12-0.62	0.002
Degree and above	1216	0.44	0.23-0.82	0.01
(missing)	(68)	--	--	--
Deprivation quintiles (IMD)				***Overall: 0.24***
Most	501	1		
Second	803	0.79	0.53-1.16	0.23
Third	288	0.52	0.29-0.93	0.027
Fourth	123	0.95	0.49-1.85	0.89
Least	47	1.05	0.40-2.78	0.92
(missing)	(62)	--	--	--
BMI				
Continuous, unit=1 kg/m^2	1737	1.04	1.01-1.07	0.007
(missing)	(87)	--	--	--
Mental health history				
No	1686	1		
Yes	71	1.60	0.78-3.30	0.20
(missing)	(67)	--	--	--
Total	**1824**			

Note: Reference groups were selected considering the sample size (the largest sample size) in the subgroups or the most (or the least) risk groups based on expectation.

Table 8. 4 Bivariate association between women's baseline characteristics and ≥20 on both subscales of the IES

	Frequency	ORs	95%CI	P
Age at delivery				
Continuous, unit=year	1765	1.02	0.97 to 1.07	0.39
(missing)	(59)			
Age-group				***Overall: 0.99***
Under 20	19	*	*	*
20-24	135	1		
25-29	315	1.59	0.44-5.80	0.48
30-34	696	1.71	0.51-5.72	0.39
35-39	478	1.62	0.47-5.62	0.45
40 +	122	1.49	0.33-6.80	0.61
(missing)	(59)	--	--	--
Parity				
Primiparity	1150	1		
Multiparity	615	0.98	0.57-1.68	0.94
(missing)	(59)	--	--	--
Ethnic groups				***Overall: 0.001***
White	1081	1		
Black	407	1.91	1.05-3.48	0.03
Asian	150	0.80	0.24-2.66	0.71
Mixed/Other	127	4.07	2.01-8.26	<0.001
(missing)	(59)	--	--	--
Women's education				***Overall: 0.14***
None	80	1		
GCSE	199	0.38	0.12-1.23	0.11
A-level	256	0.24	0.07-0.83	0.024
Degree and above	1205	0.47	0.19-1.13	0.09
(missing)	(84)	--	--	--
Deprivation quintiles (IMD)				***Overall: 0.40***
Most	496	1		
Second	800	1.08	0.61-1.92	0.79
Third	284	0.45	0.17-1.22	0.12
Fourth	119	0.65	0.19-2.23	0.49
Least	47	0.55	0.07-4.17	0.56
(missing)	(78)	--	--	--
BMI				
Continuous, unit=1 kg/m^2	1721	1.05	1.01-1.09	0.02
(missing)	(103)	--	--	--
Mental health history				
No	1671	1		
Yes	71	1.69	0.59-4.80	0.32
(missing)	(82)	--	--	--
Total	**1824**			

Note: Reference groups were selected considering the sample size (the largest sample size) in the subgroups or the most (or the least) risk groups based on expectation.

* Incalculable as no women with home delivery had PTSD symptoms defined as IES≥20 on both scales.

8.1.3 Multivariable logistic regression analysis adjusting for potential confounders

Further analysis was conducted by developing a series of multivariable logistic regression models in which one model was run without the potential confounder and another with the potential confounder to see the change in the estimated effect size of severe maternal morbidity on PTSD symptoms. The results are shown in Tables 8.5 to 8.7. Although there was a slight change in the odds ratio (ORs: measure of effect size) of having PTSD symptoms by including some variables of women's baseline characteristics, such as ethnicity and BMI, the effect size of SMM on PTSD symptoms measured by odds ratio did not change more than 10%. This result further indicated that the relationship between SMM and PTSD symptoms was not significantly confounded by women's baseline characteristics.

On the contrary, results consistently showed that severe maternal morbidly had a statistically significant effect on PTSD symptoms (ORs=2.22 to 3.33 when adjusted for all potential confounders). From these results, it can be concluded that there is a statistically significant association between severe maternal morbidity and PTSD symptoms even after adjusting for women's baseline characteristics.

Table 8. 5 Odds ratios from multivariable logistic regression analysis assessing the association between SMM and intrusion (IES≥20 on intrusion subscale) by model

	Intrusion (≥20 on IES intrusion subscale) SMM vs. non-SMM		
	ORs	95%CI	P-value
Unadjusted (crude)	2.11	1.22-3.64	0.007
Adjusted for age (continuous)	2.08	1.20-3.61	0.009
Adjusted for parity (binary)	2.11	1.22-3.64	0.008
Adjusted for ethnic groups (4 categories)	2.21	1.27-3.84	0.005
Adjusted for education (4 categories)	2.11	1.22-3.65	0.007
Adjusted for IMD (4 categories)	2.10	1.21-3.64	0.008
Adjusted for BMI (continuous)	2.24	1.29-3.89	0.004
Adjusted for mental health history (binary)	2.17	1.25-3.75	0.006
Adjusted for all potential confounders†	2.22	1.26-3.93	0.006

† adjusted for age, parity, ethnic groups, education, IMD, BMI and mental health history

Table 8. 6 Odds ratios from multivariable logistic regression analysis assessing the association between SMM and avoidance (IES≥20 on avoidance subscale) by model

	Avoidance (≥20 on IES avoidance subscale) SMM vs. non-SMM		
	ORs	95%CI	P-value
Unadjusted (crude)	3.36	2.16-5.23	<0.001
Adjusted for age (continuous)	3.39	2.17-5.30	<0.001
Adjusted for parity (binary)	3.41	2.19-5.32	<0.001
Adjusted for ethnic groups (4 categories)	3.50	2.23-5.47	<0.001
Adjusted for education (4 categories)	3.19	2.02-5.05	<0.001
Adjusted for IMD (4 categories)	3.42	2.19-5.35	<0.001
Adjusted for BMI (continuous)	3.21	2.04-5.05	<0.001
Adjusted for mental health history (binary)	3.45	2.21-5.39	<0.001
Adjusted for all potential confounders †	3.33	2.06-5.40	<0.001

† adjusted for age, parity, ethnic groups, education, IMD, BMI and mental health history

Table 8. 7 Odds ratios from multivariable logistic regression analysis assessing the association between SMM and PTSD symptoms (IES ≥20 on both subscales) by mode

	Both intrusion & avoidance (≥20 on IES both subscales) SMM vs. non-SMM		
	ORs	95%CI	P-value
Unadjusted (crude)	2.94	1.53-5.67	0.001
Adjusted for age (continuous)	2.87	1.48-5.56	0.002
Adjusted for parity (binary)	2.95	1.53-5.69	0.001
Adjusted for ethnic groups (4 categories)	3.22	1.66-6.28	0.001
Adjusted for education (4 categories)	2.91	1.51-5.62	0.001
Adjusted for IMD (4 categories)	2.89	1.49-5.56	0.002
Adjusted for BMI (continuous)	3.04	1.57-5.88	0.001
Adjusted for mental health history (binary)	3.00	1.55-5.79	0.001
Adjusted for all potential confounders †	3.22	1.62-6.43	0.001

† adjusted for age, parity, ethnic groups, education, IMD, BMI and mental health history

8.1.4 Summary

The relationship between SMM and all three indicators of PTSD symptoms (intrusion, avoidance and both intrusion and avoidance) at 6 – 8 weeks postpartum remained statistically significant, after adjusting for women's baseline characteristics.

8.2 Relationship between SMM and PTSD symptoms – Mediation effects

This section presents whether the association between SMM and PTSD symptoms were mediated by women's perceived control during labour and birth, neonatal outcomes, obstetric interventions or place of birth. As described in Chapter 5, a mediator is a variable that "represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest" (Baron & Kenny, 1986, p.1173). Contrary to confounders discussed in the previous section, the effect of mediators, which are potentially on the causal pathway between exposures to outcomes, should not be removed because removing the effect may remove the effect of the original variable (the exposure of interest), which the study is trying to demonstrate (Katz 2006b)

Again, there is no simple test to assess whether a variable is a mediator or not. However, following the definition of Baron and Kenny (1986) as described in Chapter 5, the analysis first tested the relationship between severe maternal morbidity (exposure) and women's perceived control during labour and birth (potential mediators). Next, the bivariate relationship between women's perceived control during labour and birth and PTSD symptoms (outcomes) were tested. If

women's perceived control showed a statistical significance with both SMM and PTSD symptoms, then multivariable logistic regression models were developed to see if the effect size of SMM on PTSD symptoms disappeared (fully mediated) or were reduced (partially mediated) by adding the variable of perceived control during labour and birth. The same process was repeated to test the mediation effect of neonatal outcomes, obstetric intervention and place of birth.

8.2.1 Effects of women's perceived control during labour and birth

Bivariate analysis

Women's perceived control during labour/birth and SMM

Results of bivariate analysis showed that there was a statistically significant relationship between severe maternal morbidity and low levels of perceived control during labour and birth (measured by the total score of the Labour Agentry Scale: LAS), indicating that women with SMM had a lower level of perceived control during labour and birth compared to women with no severe maternal morbidity. When looking at each item, women who had severe maternal morbidity had statistically significantly lower score on four items; 'I felt tense', 'I felt fearful', 'I felt helpless (powerless) and 'I felt like a failure' (Table 8.8).

Table 8. 8 Mean difference in LAS scores (non-SMM vs. SMM)

	No SMM Mean (SD)	All SMM cases Mean (SD)	Mean difference	(95%CI for difference)	P
1. I felt tense	4.31 (2.10)	3.46 (2.07)	0.84	(0.48 to 1.20)	<0.001
2. I felt important†	4.75 (2.23)	4.76 (2.15)	-0.01	(-0.40 to 0.37)	0.94
3. I felt confident†	4.51 (1.94)	4.55 (1.84)	-0. 04	(-0.37 to 0.29)	0.81
4. I felt in control†	4.16 (2.04)	3.82 (2.10)	0.34	(-0.01 to 0.69)	0.06
5. I felt fearful	4.75 (2.01)	4.22 (2.10)	0.52	(0.17 to 0.87)	0.003
6. I felt relaxed†	3.43 (1.99)	3.30 (1.98)	0.13	(-0.21 to 0.46)	0.46
7. I felt good about my behaviour†	5.40 (1.85)	5.28 (1.83)	0.12	(-0.19 to 0.44)	0.46
8. I felt helpless (powerless)	5.19 (1.98)	4.76 (2.14)	0.43	(0.09 to 0.77)	0.014
9. I felt I was with people who care about me†	6.09 (1.56)	6.01 (1.62)	0.09	(-0.18 to 0.35)	0.53
10. I felt like a failure	6.42 (1.31)	6.18 (1.57)	0.24	(0.01 to 0.47)	0.043
Total	48.99 (11.93)	46.15 (11.04)	2.84	(0.75 to 4.93)	0.008

Note: Women rated each item on a 7-point scale from 1 = 'almost all of the time' to 7 = 'never, or almost never'. The positively worded items† (2, 3, 4, 6, 7 and 9) were reversed. The possible total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control.

Women's perceived control during labour/birth and PTSD symptoms

Tables 8.9 to 8.11 shows mean differences in each item of the LAS score between women who had PTSD symptoms and those who did not. On almost all items of the LAS, there was evidence of statistically significant differences between women who had clinically significant level of PTSD symptoms and those who did not, indicating that women with PTSD symptoms experienced lower levels of perceived control during labour and birth.

Table 8. 9 Mean difference in LAS scores - IES intrusion subscales <20 vs. ≥20

	Intrusion<20 Mean (SD)	Intrusion≥20 Mean (SD)	Mean difference	95%CI for difference	P
1. I felt tense	4.31 (2.09)	3.33 (2.20)	0.98	0.57 to 1.39	<0.001
2. I felt important†	4.79 (2.20)	3.89 (2.39)	0.90	0.47 to 1.33	<0.001
3. I felt confident†	4.56 (1.90)	3.60 (2.12)	0.96	0.59 to 1.32	<0.001
4. I felt in control†	4.18 (2.03)	3.28 (2.15)	0.90	0.51 to 1.29	<0.001
5. I felt fearful	4.77 (1.99)	3.94 (2.24)	0.83	0.44 to 1.22	<0.001
6. I felt relaxed†	3.45 (1.98)	2.75 (1.89)	0.70	0.32 to 1.08	<0.001
7. I felt good about my behaviour†	5.44 (1.81)	4.55 (2.24)	0.88	0.53 to 1.24	<0.001
8. I felt helpless (powerless)	5.25 (1.93)	3.83 (2.31)	1.42	1.04 to 1.80	<0.001
9. I felt I was with people who care about me†	6.12 (1.53)	5.58 (1.93)	0.54	0.25 to 0.84	<0.001
10. I felt like a failure	6.44 (1.28)	5.90 (1.82)	0.54	0.28 to 0.79	<0.001
Total	49.29 (11.53)	40.49 (13.92)	8.81	6.50 to 11.12	<0.001

Note: Women rated each item on a 7-point scale from 1 = 'almost all of the time' to 7 = 'never, or almost never'. The positively worded items† (2, 3, 4, 6, 7 and 9) were reversed. The possible total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control.

Table 8. 10 Mean difference in LAS scores - IES avoidance subscales <20 vs. ≥20

	Avoidance<20 Mean (SD)	Avoidance≥20 Mean (SD)	Mean difference	95%CI for difference	P
1. I felt tense	4.37 (2.08)	2.94 (1.90)	1.43	1.08 to 1.78	<0.001
2. I felt important†	4.77 (2.21)	4.42 (2.34)	0.35	-0.02 to 0.73	0.067
3. I felt confident†	4.54 (1.91)	4.03 (2.11)	0.51	0.19 to 0.84	0.002
4. I felt in control†	4.15 (2.03)	3.73 (2.26)	0.42	0.07 to 0.76	0.019
5. I felt fearful	4.80 (1.99)	3.87 (2.16)	0.93	0.59 to 1.27	<0.001
6. I felt relaxed†	3.44 (1.98)	2.95 (2.00)	0.49	0.15 to 0.82	0.005
7. I felt good about my behaviour†	5.45 (1.81)	4.62 (2.16)	0.83	0.52 to 1.14	<0.001
8. I felt helpless (powerless)	5.28 (1.93)	3.92 (2.23)	1.35	1.02 to 1.69	<0.001
9. I felt I was with people who care about me†	6.15 (1.50)	5.41 (2.04)	0.74	0.47 to 0.99	<0.001
10. I felt like a failure	6.47 (1.24)	5.66 (1.84)	0.81	0.59 to 1.03	<0.001
Total	49.41 (11.61)	41.44 (12.97)	7.97	5.94 to 10.00	<0.001

Note: Women rated each item on a 7-point scale from 1 = 'almost all of the time' to 7 = 'never, or almost never'. The positively worded items† (2, 3, 4, 6, 7 and 9) were reversed. The possible total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control.

Table 8. 11 Mean difference in LAS scores – At least one of IES subscales (intrusion or avoidance) <20 vs. both IES subscales ≥20 (intrusion ≥20 and avoidance≥20 = IES total≥40)

	At least one subscale<20 Mean (SD)	Both subscales≥20 Mean (SD)	Mean difference	95%CI for difference	P
1. I felt tense	4.31 (2.09)	2.79 (2.02)	1.52	0.97 to 2.07	<0.001
2. I felt important†	4.78 (2.21)	3.57 (2.34)	1.21	0.63 to 1.79	<0.001
3. I felt confident†	4.53 (1.91)	3.33 (2.12)	1.21	0.70 to 1.71	<0.001
4. I felt in control†	4.15 (2.03)	3.10 (2.23)	1.05	0.51 to 1.58	<0.001
5. I felt fearful	4.77 (2.00)	3.60 (2.24)	1.17	0.64 to 1.70	<0.001
6. I felt relaxed†	3.43 (1.98)	2.45 (1.77)	0.98	0.46 to 1.50	<0.001
7. I felt good about my behaviour†	5.42 (1.82)	4.24 (2.33)	1.18	0.70 to 1.66	<0.001
8. I felt helpless (powerless)	5.22 (1.96)	3.57 (2.27)	1.65	1.13 to 2.17	<0.001
9. I felt I was with people who care about me†	6.12 (1.53)	5.22 (2.17)	0.90	0.49 to 1.30	<0.001
10. I felt like a failure	6.44 (1.28)	5.50 (2.02)	0.94	0.59 to 1.28	<0.001
Total	49.16 (11.63)	37.13 (13.48)	12.03	8.92 to 15.15	<0.001

Note: Women rated each item on a 7-point scale from 1 = 'almost all of the time' to 7 = 'never, or almost never'. The positively worded items† (2, 3, 4, 6, 7 and 9) were reversed. The possible total score ranges from 10 to 70. The higher the total score, the higher the level of experienced control.

Logistic regression analysis was further conducted to see the effect size of women's perceived control during labour and birth on PTSD symptoms (Tables 8.12 – 8.14). Results showed that for each score increase in the LAS total score, the odds of having both intrusion and avoidance symptoms (≥20 on IES intrusion subscale AND ≥20 on avoidance subscale) decreased by 8% (OR=0.92, 95%CI=0.90 to 0.94), which was statistically significant (Table 8.14). Similar results were found for intrusion symptoms (≥20 on IES intrusion subscale – Table 8.12) and avoidance symptoms (≥20 on IES avoidance subscale – Table 8.13). These results indicated

that women with low levels of perceived control during labour and birth were more likely to have PTSD symptoms.

Table 8. 12 Bivariate association between women's perceived control during labour and birth and IES ≥20 on Intrusion subscale

	Frequency	ORs	95%CI	P-value
Perceived control during labour & birth				
Continuous: unit= 1 score on LAS	1703	0.94	0.93-0.96	<0.001
(missing)	(121)			
Total	1824			

Table 8. 13 Bivariate association between women's perceived control during labour and birth and IES ≥20 on Avoidance subscale

	Frequency	ORs	95%CI	P-value
Perceived control during labour & birth				
Continuous: unit= 1 score on LAS	1705	0.95	0.93-0.96	<0.001
(missing)	(119)			
Total	1824			

Table 8. 14 Bivariate association between women's perceived control during labour and birth and IES ≥20 on both subscales

	Frequency	ORs	95%CI	P-value
Perceived control during labour & birth				
Continuous: unit= 1 score on LAS	1690	0.92	0.90-0.94	<0.001
(missing)	(134)			
Total	1824			

Multivariable logistic regression

A series of multivariable logistic regression models were developed to examine whether the relationship between SMM and PTSD symptoms was mediated by perceived control during labour and birth. The first model presented in Table 8.15 shows unadjusted odds ratios for the relationship between SMM and the three indicators of PTSD symptoms: 1) intrusion, 2) avoidance and 3) both intrusion and avoidance. The second model adjusted for women's baseline characteristics; age, parity, ethnicity and BMI. The third model explored the effect of perceived control during labour and birth as a potential mediator, while adjusting for age, parity, BMI and ethnicity. As shown in previous section, none of variables related to women's baseline characteristics met the criteria to be confounders in the current study.

Therefore, from a statistical point of view, these variables were not necessary to be included in the model or even better to be excluded since including too many variables might statistically make a model unstable. However, age, parity, BMI, ethnicity and IMD were of clinical concern as potential risk factors of poorer health outcomes, so were included except for IMD. Although there was no significant issue of colinearity between these variables, IMD was closely related to ethnicity. For example 53.4% of black women were in IMD group 1 (most deprived) compared to 19.6% of white. For this reason and because of the need to limit the number of independent variables in the logistic regression analyses to maintain validity, IMD was not included in the multivariable analyses (putting in highly related variables "may not be able to reliably assess the independent contribution of each variable" (Katz 2006, p.68)).

Results showed that there was a highly statistically significant relationship between women's perceived control during labour and birth and PTSD symptoms ($p<0.001$ for all three indicators of PTSD symptoms). The relationship between SMM and PTSD symptoms remained statistically significant ($p=0.022$ to <0.001) once the effect of women's perceived control during labour and birth and PTSD symptoms had been taken out, although the effect size of SMM on PTSD symptoms slightly reduced (from OR=2.24 to 2.04 for ≥20 on IES intrusion subscale; from OR=3.38 to 3.15 for ≥20 on avoidance subscale; and from OR=2.93 to 2.70 for ≥20 on IES both subscales). These results indicated that the relationship between SMM and PTSD symptoms was only partially mediated through women's perceived control during labour and birth.

Table 8. 15 Multivariable logistic regression analysis of the association between SMM and PTSD symptoms via women's perceived control during labour and birth

		≥20 on IES Intrusion subscales			≥20 on IES Avoidance subscales			≥20 on IES both subscales		
		ORs	**95%CI**	**P**	**ORs**	**95%CI**	**P**	**ORs**	**(95%CI)**	**P**
Model 1	**SMM (unadjusted)**									
	SMM vs. Non-SMM	**2.25**	**(1.26-4.02)**	**0.006**	**3.24**	**(2.02-5.19)**	**<0.001**	**2.82**	**(1.38-5.74)**	**0.003**
Model 2	**SMM**									
	SMM vs. Non-SMM	**2.24**	**(1.24-4.07)**	**0.008**	**3.38**	**(2.08-5.48)**	**<0.001**	**2.93**	**(1.40-6.12)**	**0.004**
	Age									
	(continuous unit=1 year)	1.02	(0.98-1.06)	0.291	1.01	(0.97-1.04)	0.72	1.03	(0.97-1.09)	0.34
	Parity									
	Multiparity vs. primiparity	0.69	(0.44-1.11)	0.123	0.99	(0.67-1.46)	0.94	0.75	(0.40-1.40)	0.36
	Ethnic groups			*Overall: 0.001*			*Overall: 0.009*			*Overall: <0.001*
	Black vs. White	2.02	(1.22-3.35)	0.006	1.89	(1.22-2.91)	0.004	1.59	(0.77-3.25)	0.21
	Asian vs. White	0.99	(0.41-2.36)	0.976	1.21	(0.62-2.37)	0.57	0.91	(0.27-3.08)	0.89
	Mixed/Other vs. White	3.23	(1.69-6.15)	0.000	2.21	(1.19-4.13)	0.013	5.42	(2.59-11.34)	<0.001
	BMI									
	(continuous unit=1kg/m^2)	1.05	(1.01-1.08)	0.014	1.02	(0.99-1.06)	0.21	1.04	(0.99-1.09)	0.15
Model 3	**SMM**									
	SMM vs. Non-SMM	**2.04**	**(1.11-3.77)**	**0.022**	**3.15**	**(1.91-5.18)**	**<0.001**	**2.70**	**(1.25-5.81)**	**0.011**
	Age									
	(continuous unit=1 year)	1.02	(0.98-1.07)	0.26	1.01	(0.97-1.04)	0.68	1.03	(0.97-1.09)	0.32
	Parity									
	Multiparity vs. primiparity	0.78	(0.49-1.25)	0.301	1.11	(0.75-1.64)	0.61	0.89	(0.47-1.67)	0.71
	Ethnic groups			*Overall: 0.001*			*Overall: 0.005*			*Overall: <0.001*
	Black vs. White	2.20	(1.32-3.66)	0.002	2.06	(1.32-3.20)	0.001	1.76	(0.86-3.63)	0.13
	Asian vs. White	0.84	(0.35-2.03)	0.70	1.07	(0.54-2.11)	0.84	0.76	(0.22-2.60)	0.66
	Mixed/Other vs. White	3.08	(1.59-5.98)	0.001	2.10	(1.11-3.97)	0.023	5.26	(2.42-11.42)	<0.001
	BMI									
	(continuous unit=1kg/m2)	1.04	(1.00-1.07)	0.058	1.01	(0.98-1.05)	0.48	1.02	(0.97-1.08)	0.35
	Perceived control - LAS									
	(continuous unit=1 score)	0.94	(0.93-0.96)	<0.001	0.95	(0.93-0.96)	<0.001	0.92	(0.90-0.94)	<0.001

Note: ORs and p-value (unadjusted and adjusted for women's baseline characteristics) might change slightly according to the model as they are calculated where respondents' answers for all other variables included in the model are known.

8.2.2 Effects of neonatal outcomes

Bivariate analysis

Neonatal outcomes and SMM

Neonatal outcomes were measured using gestational age, birth weight and NICU admission. There was a highly significant association between SMM and all the selected indicators of neonatal outcomes. For example, there was a significant association between SMM and gestational age at birth (a continuous variable), wherein a baby with an SMM mother will on average be born 0.80 weeks earlier than a baby from a non-SMM mother (Linear regression: B=-0.80; 95%CI=-1.16 to –0.45; p<0.001). As Table 8.16 shows, treating gestational age as a categorical variable, the risk of having a preterm baby was almost three times higher among women with SMM (20.4%) compared to women without SMM (6.9%).

There was also a statistically significant association between SMM and baby's birth weight—a baby born to a mother with severe maternal morbidity weighed on average 135g less than a baby born to mother without severe maternal morbidity (Linear regression: B=-134.61; 95%CI=-231.73 to -37.49; p<0.001). Similarly, treating birth weight as a categorical variable, women with SMM had a nearly four times higher chance of delivering a low birth weight baby (<2500g) (19.0%) than women without SMM (5.3%). Linear regression showed that SMM was highly associated with a lower Apgar score at one minute (B=-0.62; 95%CI=-0.83 to -0.41; p<0.001) and at five minutes (B=-0.18; 95%CI=-0.32 to -0.05, p=0.006). Chi-square test results showed that the association between SMM and the NICU admission was highly significant (p<0.001).

Table 8. 16 Bivariate association between SMM and neonatal outcomes

	All		No SMM cases		All SMM cases		
	N	%	N	%	N	%	P
Gestational age at delivery							
<37 wks	145	(7.9%)	115	(6.9%)	30	(20.4%)	<0.001†
37≤, <42 wks	1558	(85.4%)	1451	(86.5%)	107	(72.8%)	
42 wks ≤	121	(6.6%)	111	(6.6%)	10	(6.8%)	
(missing)	(0)						
Birth weight (g)							
<2500g	116	(6.4%)	88	(5.3%)	28	(19.0%)	<0.001‡
2500≤, <3500g	941	(51.8%)	894	(53.5%)	47	(32.0%)	
3500≤, <4500g	730	(40.2%)	664	(39.7%)	66	(44.9%)	
4500g ≤	31	(1.7%)	25	(1.5%)	6	(4.1%)	
(missing)	(6)		(6)		(0)		
NICU/SCBU							
No	1735	(95.2%)	1611	(96.1%)	124	(84.4%)	<0.001†
NICU	88	(4.8%)	65	(3.9%)	23	(15.6%)	
(missing)	(1)		(1)				
Total	**1824**		**1677**		**147**		

† Fisher's exact test
‡ Chi-square test

Neonatal outcomes and PTSD symptoms

Tables 8.17 to 8.19 show mean differences in Apgar scores at one and five minutes and gestational age at birth between women who had PTSD symptoms and those who did not. Women with PTSD symptoms had babies with lower Apgar scores at one and five minutes and lower gestational age compared to women who did not have PTSD symptoms (statistical significance test was performed with logistic regression analysis, which will be presented later in this section).

Table 8. 17 Mean difference in Apgar scores /gestational age - IES intrusion subscales <20 vs. ≥20

	Intrusion<20 Mean (SD)	Intrusion≥20 Mean (SD)	Mean difference	95%CI for difference
Apgar at 1 minute	8.61 (1.22)	8.24 (2.20)	0.37	(0.13 to 0.61)
Apgar at 5 minutes	9.68 (0.73)	9.47 (1.35)	0.20	(0.05 to 0.35)
Gestational age at birth	39.2 (2.08)	38.8 (2.96)	0.40	(-0.003 to 0.81)

Table 8. 18 Mean difference in Apgar scores /gestational age - IES avoidance subscales ≥20 vs. <20

	Avoidance<20 Mean (SD)	Avoidance≥20 Mean (SD)	Mean difference	95%CI for difference
Apgar at 1 minute	8.62 (1.19)	8.16 (1.95)	0.47	(-0.25 to -0.68)
Apgar at 5 minutes	9.69 (0.66)	9.31 (1.60)	0.39	(-0.26 to -0.52)
Gestational age at birth	39.2 (2.09)	38.9 (2.72)	0.36	(-0.002 to 0.72)

Table 8. 19 Mean difference in Apgar scores /gestational age –both IES subscales ≥20 (intrusion ≥20 and avoidance≥20 = IES total≥40) vs. at least one of IES subscales (intrusion or avoidance)

	At least one subscale<20 Mean (SD)	Both subscales≥20 Mean (SD)	Mean difference	95%CI for difference
Apgar at 1 minute	8,60 (1.23)	8.05 (2.15)	0.55	(-0.23 to -0.88)
Apgar at 5 minutes	9.67 (0.73)	9.30 (1.75)	0.38	(-0.18 to -0.58)
Gestational age at birth	39.19 (2.12)	38.95 (2.85)	0.24	(-0.31 to 0.79)

Tables 8.20 to 8.22 also present that the proportion of having PTSD tended to be higher for women who had babies with lower gestational age, birth weight 4500g or more, and NICU admission.

Table 8. 20 Frequency of intrusion symptoms according to neonatal outcomes

	Intrusion<20		Intrusion≥20		All	
	N	%	N	%	N	%
Gestational age at delivery						
<37 wks	129	(90.2%)	14	(9.8%)	143	(100%)
37≤, <42 wks	1430	(85.4%)	92	(6.0%)	1522	(100%)
42 wks ≤	110	(93.2%)	8	(6.8%)	118	(100%)
(missing)	--	--	--	--	(41)	--
Birth weight (g)						
<2500g	106	(91.4%)	10	(8.6%)	116	(100%)
2500≤, <3500g	849	(93.3%)	61	(6.7%)	910	(100%)
3500≤, <4500g	682	(94.7%)	38	(5.3%)	720	(100%)
4500g ≤	26	(83.9%)	5	(16.1%)	31	(100%)
(missing)	--	--	--	--	(47)	--
NICU						
No	1591	(93.9%)	103	(6.1%)	1694	(100%)
NICU	77	(87.5%)	11	(12.5%)	88	(100%)
(missing)	--	--	--	--	(42)	--
Total	**--**	**(93.6%)**	**--**	**(6.4%)**	**1824**	**--**

Table 8. 21 Frequency of avoidance symptoms according to neonatal outcomes

	Avoidance<20		Avoidance≥20		All	
	N	%	N	%	N	%
Gestational age at delivery						
<37 wks	128	(89.5%)	15	(10.5%)	143	(100%)
37≤, <42 wks	1397	(91.8%)	124	(8.2%)	1521	(100%)
42 wks ≤	106	(90.6%)	11	(9.4%)	117	(100%)
(missing)	--	--	--	--	(43)	--
Birth weight (g)						
<2500g	99	(86.1%)	16	(13.9%)	115	(100%)
2500≤, <3500g	835	(91.6%)	77	(8.4%)	912	(100%)
3500≤, <4500g	667	(93.0%)	50	(7.0%)	717	(100%)
4500g ≤	25	(80.6%)	6	(19.4%)	31	(100%)
(missing)	--	--	--	--	(49)	--
NICU						
No	1561	(92.2%)	132	(7.8%)	1693	(100%)
NICU	69	(79.3%)	18	(20.7%)	87	(100%)
(missing)	--	--	--	--	(44)	--
Total	**--**	**(91.6%)**	**--**	**(8.4%)**	**1824**	**--**

Table 8. 22 Frequency of both intrusion and avoidance symptoms according to neonatal outcomes

	At least one subscale<20		Both subscales≥20		All	
	N	%	N	%	N	%
Gestational age at delivery						
<37 wks	135	(95.7%)	6	(4.3%)	141	(100%)
37≤, <42 wks	1458	(96.7%)	50	(3.3%)	1508	(100%)
42 wks ≤	111	(95.7%)	5	(4.3%)	116	(100%)
(missing)	--	--	--	--	(59)	--
Birth weight (g)						
<2500g	111	(96.5%)	4	(3.5%)	115	(100%)
2500≤, <3500g	863	(96.0%)	36	(4.0%)	899	(100%)
3500≤, <4500g	697	(97.6%)	17	(2.4%)	714	(100%)
4500g ≤	27	(87.1%)	4	(12.9%)	31	(100%)
(missing)	--	--	--	--	(65)	--
NICU						
No	1622	(96.7%)	55	(3.3%)	1677	(100%)
NICU	81	(93.1%)	6	(6.9%)	87	(100%)
(missing)	--	--	--	--	(60)	--
Total	**--**	**(96.5%)**	**--**	**(3.5%)**	**1824**	**--**

Bivariate associations between neonatal outcomes and PTSD symptoms were further assessed with logistic regression analysis as shown in table 8.23 to 8.25. There was no evidence of significant effect of gestational age (neither treated as continuous nor categorical variable) on PTSD symptoms where both intrusion and avoidance subscales had a score of 20 or more. However, the association between gestational age (as a continuous variable) and avoidance was statistically significant (p=0.05). For each week increase in gestational age at birth, the odds of being ≥20 on IES avoidance subscale decreased by 7% (OR=0.93, 95%CI=0.87 to 1.00). The association of gestational age (as a continuous variable) with an IES intrusion subscale score of 20 or more just failed to reach statistical significance (p=0.053).

Birth weight was treated as a continuous variable; it was significantly associated with avoidance (≥20 on avoidance subscale, p=0.025), but not with intrusion (≥20 on intrusion subscale, p=0.19) or PTSD symptoms with ≥20 on both subscales (p=0.39). When birth weight was treated as a categorical variable ('<2500g', '2500≤, <3500g', '3500≤, <4500g' and '4500g or more'), the overall p-value became statistically significant (p=0.013 for avoidance, p=0.018 for both subscales) or close to significant (p=0.07 for intrusion). Women who had babies weighing '3500≤, <4500g' had lower odds of having intrusion, avoidance or both intrusion and avoidance than any of the other birth weight groups.

Logistic regression consistently showed that women with babies with lower Apgar scores at one minute were significantly more likely to have a higher risk of any of the three indicators of PTSD symptoms (p=0.003 for intrusion, p<0.001 for avoidance and p=0.001 for both subscale symptoms), as was Apgar score at five minutes (p=0.01 for intrusion, p<0.001 for avoidance and p=0.001 for both subscale

symptoms). NICU admission was significantly associated with symptoms of intrusion and avoidance; the odds of these symptoms were higher in women whose infants were admitted to the NICU than women with babies without NICU admission. However, evidence of the effect of the NICU admission on both intrusion and avoidance symptoms (≥20 on IES both subscales) was not enough, although it was close to significance (p=0.08).

Table 8. 23 Bivariate association between neonatal outcomes and IES ≥20 on Intrusion subscale

	Frequency	ORs	95%CI	P-value
Gestational age at birth				
Continuous: unit=week	1783	0.93	0.86-1.00	**0.053**
(missing)	(41)			
Gestational age at birth				***Overall: 0.22***
<37 wks	143	1		
37≤, <42 wks	1522	0.59	0.33-1.07	0.83
42 wks ≤	118	0.67	0.27-1.66	0.39
(missing)	(41)	--	--	--
Birth weight (g)				
Continuous: unit=g	1777	1.00	0.99-1.00	**0.19**
(missing)	(47)			
Birth weight (g)				***Overall: 0.07***
<2500g	116	1		
2500≤, <3500g	910	0.76	0.38-1.53	0.45
3500≤, <4500g	720	0.59	0.29-1.22	0.16
4500g ≤	31	2.04	0.64-6.48	0.23
(missing)	(47)	--	--	--
Apgar at 1 minute				
Continuous: unit=1 score	1775	0.84	0.75-0.94	**0.003**
(missing)	(49)	--	--	--
Apgar at 5 minutes				
Continuous: unit=1 score	1777	0.80	0.67-0.95	**0.01**
(missing)	(47)	--	--	--
NICU admission				
No	1694	1		
Yes	88	2.21	1.14-4.28	**0.019**
(missing)	(42)	--	--	--
Total	**1824**			

Table 8. 24 Bivariate association between neonatal outcomes and IES ≥20 on Avoidance subscale

	Frequency	ORs	95%CI	P-value
Gestational age at birth				
Continuous: unit=week	1781	0.93	0.87-1.00	**0.05**
(missing)	(43)			
Gestational age at birth				***Overall: 0.58***
<37 wks	143	1		
37≤, <42 wks	1521	0.76	0.43-1.33	0.34
42 wks ≤	117	0.89	0.39-2.01	0.77
(missing)	(43)	--	--	--
Birth weight (g)				
Continuous: unit=g	1775	1.00	0.99-1.00	**0.025**
(missing)	(49)			
Birth weight (g)				***Overall: 0.013***
<2500g	115	1		
2500≤, <3500g	912	0.57	0.32-1.02	0.06
3500≤, <4500g	717	0.46	0.25-0.85	0.01
4500g ≤	31	1.49	0.53-4.18	0.45
(missing)	(49)	--	--	--
Apgar at 1 minute				
Continuous: unit=1 score	1773	0.81	0.73-0.89	**<0.001**
(missing)	(51)	--	--	--
Apgar at 5 minutes				
Continuous: unit=1 score	1775	0.68	0.58-0.79	**<0.001**
(missing)	(49)	--	--	--
NICU admission				
No	1693	1		
Yes	87	3.09	1.78-5.34	**<0.001**
(missing)	(44)	--	--	--
Total	**1824**			

Table 8. 25 Bivariate association between neonatal outcomes and IES ≥20 on both subscales

	Frequency	ORs	95%CI	P-value
Gestational age at birth				
Continuous: unit=week	1765	0.96	0.86-1.06	**0.40**
(missing)	(59)			
Gestational age at birth				***Overall: 0.74***
<37 wks	141	1		
37≤, <42 wks	1508	0.77	0.33-1.83	0.56
42 wks ≤	116	1.01	0.30-3.41	0.93
(missing)	(59)	--	--	--
Birth weight (g)				
Continuous: unit=g	1759	1.00	0.99-1.00	**0.39**
(missing)	(65)			
Birth weight (g)				***Overall: 0.018***
<2500g	115	1		
2500≤, <3500g	899	1.16	0.40-3.31	0.79
3500≤, <4500g	714	0.68	0.22-2.05	0.49
4500g ≤	31	4.11	0.97-17.50	0.056
(missing)	(65)	--	--	--
Apgar at 1 minute				
Continuous: unit=1 score	1757	0.80	0.69-0.91	**0.001**
(missing)	(67)	--	--	--
Apgar at 5 minutes				
Continuous: unit=1 score	1759	0.73	0.60-0.88	**0.001**
(missing)	(65)	--	--	--
NICU admission				
No	1677	1		
Yes	87	2.19	0.91-5.22	**0.08**
(missing)	(60)	--	--	--
Total	**1824**			

Multivariable logistic regression

So far, bivariate analysis showed that a number of neonatal conditions were associated with PTSD symptoms. Of these variables, low Apgar scores at one and at five minutes consistently showed a statistically significant association with all three indicators of PTSD symptoms. Both Apgar scores at one minute and five minutes were considered to be potential mediators. It was however necessary to select one variable, as Apgar score at one and five minutes were highly correlated. The Apgar score at five minutes was selected as it had a slightly greater effect on PTSD symptoms based on the odds ratios and therefore was considered to be a better indicator of neonatal outcomes in relation to PTSD symptoms.

Table 8.26 shows the results of a series of logistic regression models to explore the mediator effect of the Apgar score at five minutes on the association between SMM and PTSD symptoms. Results showed that when the Apgar score at five minutes was added to the model, the effects of SMM on PTSD symptoms measured with odds ratios slightly weakened (see ORs of SMM in model 2 and model 3). The statistical significance of Apgar score at five minutes remained against avoidance symptoms (≥20 on IES avoidance subscale) and severe cases of PTSD symptoms (≥20 on both intrusion and avoidance subscales), even after SMM and women's baseline characteristics were included in the model. However the relationship between the Apgar score and intrusion was no longer significant (p=0.07). The evidence was thus not enough to show a significant mediation effect of the Apgar score at five minutes on the relationship between SMM and intrusion symptoms. However, since statistical significance of SMM against all three indicators of PTSD symptoms remained, it can be concluded that any mediation effects of poor neonatal outcomes was partial.

Table 8. 26 Multivariable logistic regression analysis of the association between SMM and PTSD symptoms via Apgar score at 5 minutes (including potential confounders)

		≥20 on IES Intrusion subscales			≥20 on IES Avoidance subscales			≥20 on IES both subscales		
		ORs	**95%CI**	**P**	**ORs**	**95%CI**	**P**	**ORs**	**(95%CI)**	**P**
Model 1	**SMM (unadjusted)**									
	SMM vs. Non-SMM	**2.24**	**(1.29-3.88)**	**0.004**	**3.29**	**(2.10-5.16)**	**<0.001**	**3.05**	**(1.58-5.89)**	**0.001**
Model 2	**SMM**									
	SMM vs. Non-SMM	**2.19**	**(1.25-3.85)**	**0.006**	**3.33**	**(2.10-5.28)**	**<0.001**	**3.06**	**(1.55-6.04)**	**0.001**
	Age									
	(continuous unit=1 year)	1.03	(0.99-1.07)	0.19	1.01	(0.98-1.05)	0.50	1.04	(0.99-1.09)	0.17
	Parity									
	Multiparity vs. primiparity	0.73	(0.47-1.14)	0.17	0.96	(0.66-1.40)	0.84	0.79	(0.44-1.42)	0.42
	Ethnic groups			*Overall: 0.001*			*Overall: 0.004*			*Overall: <0.001*
	Black vs. White	2.18	(1.35-3.51)	0.001	2.05	(1.35-3.10)	0.001	1.83	(0.94-3.55)	0.07
	Asian vs. White	0.96	(0.40-2.28)	0.92	1.20	(0.62-2.34)	0.60	0.90	(0.27-3.04)	0.87
	Mixed/Other vs. White	3.16	(1.69-5.90)	<0.001	2.03	(1.09-3.78)	0.025	5.04	(2.42-10.48)	<0.001
	BMI									
	(continuous unit=1kg/m^2)	1.05	(1.01-1.08)	0.008	1.03	(0.99-1.06)	0.10	1.05	(1.00-1.10)	0.052
Model 3	**SMM**									
	SMM vs. Non-SMM	**2.15**	**(1.22-3.77)**	**0.008**	**3.20**	**(2.01-5.10)**	**<0.001**	**2.99**	**(1.51-5.91)**	**0.002**
	Age									
	(continuous unit=1 year)	1.03	(0.99-1.07)	0.21	1.01	(0.98-1.05)	0.54	1.04	(0.98-1.09)	0.18
	Parity									
	Multiparity vs. primiparity	0.76	(0.49-1.19)	0.24	1.03	(0.71-1.51)	0.87	0.86	(0.48-1.55)	0.61
	Ethnic groups			*Overall: 0.001*			*Overall: 0.008*			*Overall: <0.001*
	Black vs. White	2.09	(1.29-3.38)	0.003	1.91	(1.26-2.91)	0.003	1.65	(0.84-3.23)	0.14
	Asian vs. White	0.97	(0.41-2.32)	0.95	1.24	(0.64-2.43)	0.52	0.94	(0.28-3.16)	0.92
	Mixed/Other vs. White	3.20	(1.71-5.97)	<0.001	2.10	(1.13-3.90)	0.02	5.18	(2.49-10.79)	<0.001
	BMI									
	(continuous unit=1kg/m2)	1.05	(1.01-1.09)	0.008	1.03	(0.99-1.06)	0.10	1.05	(0.99-1.10)	0.055
	Apgar score at 5 min.									
	(continuous unit=1 score)	0.84	(0.71-1.01)	0.07	0.72	(0.61-0.84)	<0.001	0.75	(0.62-0.92)	0.005

Note: ORs and p-value (unadjusted and adjusted for women's baseline characteristics) might change slightly according to the model as they are calculated where respondents' answers for all other variables included in the model are known.

8.2.3 Effects of obstetric interventions

Bivariate analysis

Obstetric intervention and SMM

High medical intervention is often necessary to manage maternal complications. In the sample of the current study, there was a statistically significant relationship between mode of birth and SMM. Women with SMM had a higher rate of emergency caesarean birth or EmCS (48%) compared to women without SMM (17%). The percentage of spontaneous vaginal birth or SVD was lower for women with SMM (approximately 22%) compared to women without SMM (58%). There was a statistically significant relationship between the manual removal of placenta and SMM. The results are presented in Table 8.27.

Table 8. 27 Percentage of women receiving different level of intervention, by SMM status

	All		No SMM cases		All SMM cases		
	N	%	N	%	N	%	P
Mode of delivery							
SVD	1002	(54.9%)	970	(57.8%)	32	(21.8%)	<0.001‡
Breech/instrumental	300	(16.4%)	275	(16.4%)	25	(17.0%)	
EICS	164	(9.0%)	144	(8.6%)	20	(13.6%)	
EmCS	358	(19.6%)	288	(17.2%)	70	(47.6%)	
(missing)	(0)	--	(0)		(0)		
Total	**1824**		**1677**		**147**		
Manual removal of placenta							
No	1270	69.6%	1217	(72.6%)	53	(36.1%)	<0.048†
Manual removal	32	1.8%	28	(1.7%)	4	(2.7%)	
(missing)	(0)	--	(0)	--	(0)	--	
Total	**1302**		**1245**		**57**		

SVD=spontaneous vagina delivery, EICS=elective caesarean section, EmCS=emergency caesarean section, CS=caesarean section

† Fisher's exact test

‡ Chi-square test

Obstetric intervention and PTSD symptoms

The proportion of having PTSD symptoms according to the different level of obstetric intervention was presented in Tables 8.28 to 8.30 followed by statistical significant test with logistic regression analyses (Table 8.31 to 8.34).

The highest proportion of having PTSD symptoms was observed in women who had emergency caesarean birth followed by those who had elective caesarean birth. This was consistent across all three indicators of PTSD symptoms (intrusion, avoidance and both intrusion and avoidance). Of women who had vaginal birth, the proportion of PTSD symptoms was higher among women with manual removal of placenta compared to women without.

Table 8. 28 Frequency of intrusion symptoms according to obstetric intervention

	Intrusion<20		Intrusion≥20		All	
	N	%	N	%	N	%
Mode of delivery						
SVD	923	(94.4%)	55	(5.6%)	978	(100%)
Breech/Forceps/Ventouse	282	(95.3%)	14	(4.7%)	296	(100%)
EICS	151	(93.2%)	11	(6.8%)	162	(100%)
EmCS	313	(90.2%)	34	(9.8%)	347	(100%)
(missing)	--	--	--	--	(41)	--
Manual removal of placenta						
No	1177	(94.8%)	65	(5.2%)	1242	(100%)
Manual removal	28	(87.5%)	4	(12.5%)	32	(100%)
(Not applicable - CS)	(464)	(91.2%)	(45)	(8.8%)	(509)	(100%)
(missing)	--	--	--	--	(41)	--
Total	**--**	**(93.6%)**	**--**	**(6.4%)**	**1824**	**--**

Table 8. 29 Frequency of avoidance symptoms according to obstetric intervention

	Avoidance<20		Avoidance≥20		All	
	N	%	N	%	N	%
Mode of delivery						
SVD	916	(93.9%)	59	(6.1%)	975	(100%)
Breech/Forceps/Ventouse	280	(94.0%)	18	(6.0%)	298	(100%)
EICS	143	(88.8%)	18	(11.2%)	161	(100%)
EmCS	292	(84.1%)	55	(15.9%)	347	(100%)
(missing)	--	--	--	--	(43)	--
Manual removal of placenta						
No	1166	(94.0%)	75	(6.0%)	1241	(100%)
Manual removal	30	(93.8%)	2	(6.2%)	32	(100%)
(Not applicable - CS)	(435)	(85.6%)	(73)	(14.4%)	(508)	(100%)
(missing)	--	--	--	--	(43)	--
Total	**--**	**(91.6%)**	**--**	**(8.4%)**	**1824**	**--**

Table 8. 30 Frequency of both intrusion and avoidance symptoms according to obstetric intervention

	At least one subscale<20		Both subscales≥20		All	
	N	%	N	%	N	%
Mode of delivery						
SVD	941	(97.5%)	24	(2.5%)	965	(100%)
Breech/Forceps/Ventouse	288	(97.3%)	8	(2.7%)	296	(100%)
EICS	154	(95.7%)	7	(4.3%)	161	(100%)
EmCS	321	(93.6%)	22	(6.4%)	343	(100%)
(missing)	--	--	--	--	(59)	--
Manual removal of placenta						
No	1198	(97.5%)	31	(2.5%)	1229	(100%)
Manual removal	31	(96.9%)	1	(3.1%)	32	(100%)
(Not applicable - CS)	475	(94.2%)	29	(5.8%)	504	(100%)
(missing)	--	--	--	--	(59)	--
Total	**--**	**(96.5%)**	**--**	**(3.5%)**	**1824**	**--**

Logistic regression analysis showed significantly higher odds of any of the three indicators of PTSD symptoms among women who had an emergency caesarean birth, compared to women with SVD, showing the statistically significant effects of mode of birth on PTSD symptoms. Higher odds of avoidance symptoms (≥20 on the IES avoidance subscale) were also observed in women with elective caesarean section when compared to women with SVD, but there were no differences in intrusion symptoms (≥20 on the IES intrusion subscale) or both subscales (≥20 on both intrusion and avoidance subscales) between these groups. There were no significant differences in odds of PTSD symptoms among women with assisted breech delivery or instrumental vaginal birth when compared to women with SVD.

Moreover, there was no evidence of the statistically significant effects of manual removal of placenta on any of the three indicators of PTSD symptoms, but with such a small number of cases, the statistical power to detect the difference appeared to be not enough. The results of bivariate analysis between obstetric intervention and PTSD symptoms are presented in Table 8.31 (intrusion subscale), Table 8.32 (avoidance subscale) and Table 8.33 (both intrusion and avoidance subscales).

Table 8. 31 Bivariate association between obstetric intervention and IES ≥20 on intrusion

	Frequency	ORs	95%CI	P-value
Mode of delivery				***Overall: 0.031***
SVD	978	1		
Breech/Forceps/Ventouse	296	0.83	0.46 to 1.52	0.55
EICS	162	1.22	0.63 to 2.39	0.56
EmCS	347	1.82	1.17 to 2.85	0.008
(missing)	(41)	--		
Manual removal of placenta				***Overall:0.008***
No	1242	1		
Manual removal	32	2.59	0.88 to 7.58	0.08
(Not applicable - CS)	(509)	(1.76)	(1.18 to 2.61)	(0.005)
(missing)	(41)			
Total	**1824**			

SVD=spontaneous vagina delivery, EICS=elective caesarean section, EmCS=emergency caesarean section, CS=caesarean section

Table 8. 32 Bivariate association between obstetric intervention and IES ≥20 on avoidance

	Frequency	ORs	95%CI	P-value
Mode of delivery				***Overall: <0.001***
SVD	975	1		
Breech/Forceps/Ventouse	298	0.99	0.58 to 1.72	0.99
EICS	161	1.95	1.12 to 3.41	0.018
EmCS	347	2.92	1.98 to 4.32	<0.001
(missing)	(43)	--		
Manual removal of placenta				***Overall: 0.01***
No	1241	1		
Manual removal	32	1.04	0.24 to 4.42	0.96
(Not applicable - CS)	(508)	(2.61)	(1.86 to 3.67)	(<0.001)
(missing)	(43)			
Total	**1824**			

SVD=spontaneous vagina delivery, EICS=elective caesarean section, EmCS=emergency caesarean section, CS=caesarean section

Table 8. 33 Bivariate association between obstetric intervention and IES ≥20 on IES both subscales

	Frequency	ORs	95%CI	P-value
Mode of delivery				***Overall: 0.008***
SVD	965	1		
Breech/Forceps/Ventouse	296	1.09	0.48 to 2.45	0.84
Elective CS	161	1.78	0.76 to 4.21	0.19
Emergency CS	343	2.69	1.49 to 4.86	0.001
(missing)	(59)	--		
Manual removal of placenta				***Overall: 0.005***
No	1229	1		
Manual removal	32	1.25	0.17 to 9.43	0.83
(Not applicable - CS)	(504)	(2.36)	(1.41 to 3.96)	(0.001)
(missing)	(59)			
Total	**1824**			

SVD=spontaneous vagina delivery, EICS=elective caesarean section, EmCS=emergency caesarean section, CS=caesarean section

Multivariable logistic regression

The bivariate analysis described above showed that the mode of birth was statistically significantly associated with both SMM and PTSD symptoms. This was particularly marked for emergency caesarean section. To examine whether the effects of SMM on PTSD symptoms were mediated by mode of birth, multivariable logistic regression models were further developed. Results consistently showed that the odds ratio was slightly reduced when the mode of birth was added in the model, but even after the adjustment for it, the relationship between SMM and PTSD symptoms remained statistically significant, implying a direct association between SMM and PTSD symptoms. It is also important to note that emergency caesarean section was no longer significantly associated with intrusion symptoms and with both intrusion and avoidance symptoms when women's baseline characteristics and SMM were added in the models, although it was still significantly associated with avoidance symptoms. This showed insufficient evidence to determine that emergency caesarean section acts as a mediator between SMM and PTSD symptoms except for avoidance symptoms.

Table 8. 34 Multivariable logistic regression analysis of the association between SMM and PTSD symptoms via mode of birth

		≥20 on IES Intrusion subscales			≥20 on IES Avoidance subscales			≥20 on IES both subscales		
		ORs	**95%CI**	**P**	**ORs**	**95%CI**	**P**	**ORs**	**(95%CI)**	**P**
Model 1	**SMM (unadjusted)**									
	SMM vs. Non-SMM	**2.25**	**(1.30-3.90)**	**0.004**	**3.31**	**(2.11-5.18)**	**<0.001**	**3.06**	**(1.58-5.92)**	**0.001**
Model 2	**SMM**									
	SMM vs. Non-SMM	**2.20**	**(1.26-3.87)**	**0.006**	**3.35**	**(2.11-5.31)**	**<0.001**	**3.07**	**(1.56-6.07)**	**0.001**
	Age									
	(continuous unit=1 year)	1.03	(0.99-1.07)	0.19	1.01	(0.98-1.05)	0.50	1.04	(0.99-1.09)	0.17
	Parity									
	Multiparity vs. primiparity	0.74	(0.47-1.15)	0.17	0.96	(0.66-1.41)	0.85	0.79	(0.44-1.42)	0.43
	Ethnic groups			*Overall: 0.001*			*Overall: 0.004*			*Overall: <0.001*
	Black vs. White	2.18	(1.35-3.52)	0.001	2.05	(1.35-3.11)	0.001	1.84	(0.95-3.56)	0.07
	Asian vs. White	0.96	(0.40-2.29)	0.93	1.20	(0.62-2.35)	0.59	0.91	(0.27-3.06)	0.88
	Mixed/Other vs. White	3.18	(1.70-5.94)	<0.001	2.04	(1.10-3.80)	0.024	5.06	(2.43-10.54)	<0.001
	BMI									
	(continuous unit=1kg/m^2)	1.05	(1.01-1.08)	0.009	1.03	(0.99-1.06)	0.11	1.05	(1.00-1.10)	0.053
Model 3	**SMM**									
	SMM vs. Non-SMM	**2.03**	**(1.13-3.64)**	**0.018**	**2.58**	**(1.59-4.18)**	**<0.001**	**2.52**	**(1.24-5.13)**	**0.011**
	Age									
	(continuous unit=1 year)	1.02	(0.98-1.06)	0.25	1.00	(0.97-1.04)	0.95	1.03	(0.98-1.08)	0.29
	Parity									
	Multiparity vs. primiparity	0.76	(0.48-1.20)	0.23	1.09	(0.73-1.62)	0.68	0.89	(0.48-1.64)	0.70
	Ethnic groups			*Overall: 0.001*			*Overall: 0.009*			*Overall: <0.001*
	Black vs. White	2.12	(1.31-3.43)	0.002	1.91	(1.26-2.90)	0.002	1.74	(0.89-3.36)	0.10
	Asian vs. White	0.97	(0.40-2.31)	0.94	1.22	(0.62-2.38)	0.57	0.91	(0.27-3.08)	0.88
	Mixed/Other vs. White	3.20	(1.71-5.98)	<0.001	2.07	(1.11-3.87)	0.022	5.08	(2.43-10.60)	<0.001
	BMI									
	(continuous unit=1kg/m2)	1.05	(1.01-1.08)	0.014	1.02	(0.99-1.05)	0.24	1.04	(0.99-1.09)	0.10
	Mode of birth			*Overall: 0.58*			*Overall: 0.001*			*Overall: 0.24*
	Breech/forceps/ventouse vs. SVD	0.84	(0.45-1.58)	0.59	0.97	(0.54-1.72)	0.90	1.00	(0.43-2.34)	0.99
	Elective CS vs. SVD	0.99	(0.49-2.04)	0.99	1.61	(0.89-2.89)	0.11	1.28	(0.50-3.26)	0.61
	Emergency CS vs. SVD	1.31	(0.79-2.18)	0.29	2.33	(1.51-3.59)	<0.001	1.92	(0.99-3.75)	0.06

Note: ORs and p-value (unadjusted and adjusted for women's baseline characteristics) might change slightly according to the model as they are calculated where respondents' answers for all other variables included in the model are known.

8.2.4 Effects of place of birth

Bivariable anaysis

Place of birth and SMM

There was a high statistically significant relationship between SMM and the place of birth. The majority (90.5%) of women with SMM gave birth at the obstetric maternity unit; the percentage was higher than women without SMM (74.8%). On the other hand, a smaller percentage of women with SMM (6.8%) gave birth in an alongside midwifery unit, while the corresponding figure for women without SMM was 20.2%. Of women with SMM, 2.7% gave birth before their arrival at the hospital. None of the women with SMM had a planned home birth with community midwives.

Table 8. 35 Percentage of women receiving different types of maternity care, by SMM status

	All		No SMM cases		All SMM cases		
Place of birth	N	%	N	%	N	%	P
Obstetric unit	1388	(76.1%)	1255	(74.8%)	133	(90.5%)	<0.001†
Alongside midwifery unit	348	(19.1%)	338	(20.2%)	10	(6.8%)	
Planned home birth	51	(2.8%)	51	(3.0%)	0	(0%)	
BBA	37	(2.0%)	33	(2.0%)	4	(2.7%)	
(missing)	(0)	--	(0)	--	(0)	--	
Total	**1824**		**1677**		**147**		

† Fisher's exact test

Place of birth and PTSD symptoms

Tables 8.36 to 8.38 show the proportion of having PTSD symptoms according to the place of birth. The proportion of PTSD symptoms was the highest among women who had birth in 'other' (eg. giving birth before arriving hospital) followed by women gave birth in obstetric unit.

Table 8. 36 Frequency of intrusion symptoms according to place of birth

	Intrusion<20		Intrusion≥20		All	
Place of birth	N	%	N	%	N	%
Obstetric unit	1264	(93.4%)	90	(6.6%)	1354	(100%)
Alongside midwifery unit	324	(95.0%)	17	(5.0%)	341	(100%)
Planned home birth	50	(98.0%)	1	(2.0%)	51	(100%)
BBA	31	(83.8%)	6	(16.2%)	37	(100%)
(missing)	--	--	--	--	(41)	--
Total					**1824**	

Table 8. 37 Frequency of avoidance symptoms according to place of birth

	Avoidance<20		Avoidance≥20		All	
Place of birth	N	%	N	%	N	%
Obstetric unit	1233	(91.0 %)	122	(9.0%)	1355	(100%)
Alongside midwifery unit	317	(93.8%)	21	(6.2%)	338	(100%)
Planned home birth	50	(98.0%)	1	(2.0%)	51	(100%)
BBA	31	(83.8%)	6	(16.2%)	37	(100%)
(missing)	--	--	--	--	(43)	--
Total					**1824**	

Table 8. 38 Frequency of both intrusion and avoidance symptoms according to place of birth

	At least one subscale<20		Both subscales≥20		All	
Place of birth	N	%	N	%	N	%
Obstetric unit	1292	(96.3%)	49	(3.7%)	1341	(100%)
Alongside midwifery unit	328	(97.6%)	8	(2.4%)	336	(100%)
Planned home birth	51	(100%)	0	(0%)	51	(100%)
BBA	33	(89.2%)	4	(6.6%)	37	(100%)
(missing)	--	--	--	--	(59)	--
Total					**1824**	

Statistical significance between place of birth and PTSD symptoms was further tested with bivariate logistic regression analysis (Tables 8.39 to 8.41). Overall, the relationship between place of birth and PTSD symptoms was statistically significant or close to significant. However, the logistic regression results indicated that the overall significance appeared to be attributed to the higher odds of having PTSD symptoms among women who gave birth before arriving at hospital compared to women who gave birth at an obstetric unit. There was no evidence of statistically significant association between an obstetric unit and an alongside midwifery unit, although the odds of having PTSD symptoms tended to be lower in women who gave birth in the alongside midwifery unit, compared to women who gave birth at an

obstetric unit. Note that none of women with home birth had SMM or PTSD symptoms defined as IES≥20 on both scales.

Table 8. 39 Bivariate association between place of birth and IES ≥20 on intrusion

	Frequency	ORs	95%CI	P-value
Place of birth				***Overall: 0.044***
Obstetric unit	1354	1		
Alongside midwifery unit	341	0.74	0.43 to 1.26	0.26
Planned home birth	51	0.28	0.04 to 2.06	0.21
BBA	37	2.72	1.11 to 6.69	0.029
(missing)	(41)	--		
Total	**1824**			

Table 8. 40 Bivariate association between obstetric intervention and IES ≥20 on avoidance

	Frequency	ORs	95%CI	P-value
Place of birth				***Overall: 0.053***
Obstetric unit	1355	1		
Alongside midwifery unit	338	0.67	0.42 to 1.08	0.10
Planned home birth	51	0.20	0.03 to 1.48	0.12
BBA	37	1.96	0.80 to 4.78	0.14
(missing)	(43)	--		
Total	**1824**			

Table 8. 41 Bivariate association between obstetric intervention and IES ≥20 on IES both subscales

	Frequency	ORs	95%CI	P-value
Place of birth				***Overall: 0.097***
Obstetric unit	1341	1		
Alongside midwifery unit	336	0.64	0.30 to 1.37	0.25
Planned home birth	51	*	*	*
BBA	37	3.20	1.90 to 9.38	0.034
(missing)	(59)	--		
Total	**1824**			

* Incalculable as no women with home delivery had PTSD symptoms defined as IES≥20 on both scales.

Multivariable logistic regression

Table 8.42 showed the results of series of multivariable regression analysis to explore the mediation effect of place of birth on the relationship between SMM and PTSD symptoms, while adjusting for women's baseline characteristics. Results indicated that overall significance of the place of birth in the relationship with PTSD, which was observed in bivariate analysis, disappeared when SMM and women's baseline characteristics was entered in the model together. On the other hand, the relationship between SMM and PTSD symptoms remained statistically significant.

These results implied that the relationship between SMM and PTSD symptoms were not mediated by place of birth. It is, however, worth noting that odds of having clinically significant level of intrusion symptoms (p=0.025) and both intrusion and avoidance symptoms (p=0.037) were significantly higher among women whose babies were born before arrival at the hospital than women who gave birth at the obstetric unit.

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Table 8. 42 Multivariable logistic regression analysis of the association between SMM and PTSD symptoms via place of birth

		≥20 on IES Intrusion subscales			≥20 on IES Avoidance subscales			≥20 on IES both subscales		
		ORs	95%CI	P	ORs	95%CI	P	ORs	(95%CI)	P
Model 1	**SMM (unadjusted)**									
	SMM vs. Non-SMM	**2.25**	**(1.30-3.90)**	**0.004**	**3.31**	**(2.11-5.18)**	**<0.001**	**3.06**	**(1.58-5.92)**	**0.001**
Model 2	**SMM**									
	SMM vs. Non-SMM	**2.20**	**(1.26-3.87)**	**0.006**	**3.35**	**(2.11-5.31)**	**<0.001**	**3.07**	**(1.56-6.07)**	**0.001**
	Age									
	(continuous unit=1 year)	1.03	(0.99-1.07)	0.19	1.01	(0.98-1.05)	0.50	1.04	(0.99-1.09)	0.17
	Parity									
	Multiparity vs. primiparity	0.74	(0.47-1.15)	0.17	0.96	(0.66-1.41)	0.85	0.79	(0.44-1.42)	0.43
	Ethnic groups			*Overall: 0.001*			*Overall: 0.004*			*Overall: <0.001*
	Black vs. White	2.18	(1.35-3.52)	0.001	2.05	(1.35-3.11)	0.001	1.84	(0.95-3.56)	0.07
	Asian vs. White	0.96	(0.40-2.29)	0.93	1.20	(0.62-2.35)	0.59	0.91	(0.27-3.06)	0.88
	Mixed/Other vs. White	3.18	(1.70-5.94)	<0.001	2.04	(1.10-3.80)	0.024	5.06	(2.43-10.54)	<0.001
	BMI									
	(continuous unit=1kg/m^2)	1.05	(1.01-1.08)	0.009	1.03	(0.99-1.06)	0.11	1.05	(1.00-1.10)	0.053
Model 3	**SMM**									
	SMM vs. Non-SMM	**2.15**	**(1.22-3.79)**	**0.008**	**3.22**	**(2.02-5.13)**	**<0.001**	**2.92**	**(1.47-5.82)**	**0.002**
	Age									
	(continuous unit=1 year)	1.03	(0.99-1.07)	0.21	1.01	(0.98-1.05)	0.56	1.04	(0.98-1.09)	0.19
	Parity									
	Multiparity vs. primiparity	0.71	(0.45-1.12)	0.14	0.97	(0.66-1.43)	0.89	0.75	(0.41-1.38)	0.36
	Ethnic groups			*Overall: 0.001*			*Overall: 0.008*			*Overall: <0.001*
	Black vs. White	2.10	(1.30-3.41)	0.003	1.97	(1.29-2.99)	0.002	1.74	(0.89-3.39)	0.10
	Asian vs. White	0.94	(0.39-2.25)	0.89	1.17	(0.60-2.29)	0.65	0.87	(0.26-2.94)	0.82
	Mixed/Other vs. White	3.11	(1.66-5.82)	0.000	1.98	(1.06-3.69)	0.032	4.87	(2.32-10.19)	<0.001
	BMI									
	(continuous unit=1kg/m2)	1.05	(1.01-1.09)	0.009	1.03	(0.99-1.06)	0.14	1.05	(0.99-1.10)	0.06
	Place of birth			*Overall: 0.12*			*Overall: 0.32*			*Overall: 0.21*
	Alongside midwifery vs. obstetric unit	0.96	(0.54-1.69)	0.89	0.87	(0.53-1.44)	0.60	0.93	(0.42-2.04)	0.85
	Planned home vs. obstetric unit	0.46	(0.06-3.41)	0.45	0.30	(0.04-2.22)	0.24	*	*	*
	BBA vs. obstetric unit	2.89	(1.14-7.34)	0.025	1.84	(0.73-4.61)	0.20	3.35	(1.08-10.43)	0.037

Note: ORs and p-value (unadjusted and adjusted for women's baseline characteristics) might change slightly according to the model as they are calculated where respondents' answers for all other variables included in the model are known.
* Incalculable as no women with home delivery had PTSD symptoms defined as IES≥20 on both scales.

8.2.5 Summary

The relationship between SMM and the three indicators of PTSD symptoms at 6 – 8 weeks postpartum were partially mediated though perceived control of women during labour and birth and neonatal outcomes as measured by the Apgar score at five minutes. Mode of birth particularly emergency caesarean birth also partially acted as a mediator for the relationship between SMM and avoidance symptom. However there was insufficient evidence to declare that mode of birth had a mediator effect on the relationship between SMM and intrusion symptoms or between SMM and severe cases of PTSD symptoms (20 or more on both intrusion and avoidance symptoms). There was no evidence to show that the relationship between SMM and PTSD symptoms was mediated by place of birth. Importantly, none of potential mediators tested in this study eliminated the significance of SMM against PTSD symptoms, indicating that there was a direct relationship between them.

8.3 Relationship between SMM and PTSD symptoms, taking account of postnatal factors

This section assesses the association between SMM and PTSD symptoms, while taking into account postnatal social support (measured with the Social Support Scale: SSS and living arrangements) and other perceived distress event[26] in the first 6 weeks after birth.

[26] A perceived stress event was measured with this question: "Aside from your birth, have you experienced any changes in your life within the last six weeks, which have caused you anxiety or depression?"

8.3.1 Bivariable analysis

Analysis started with consideration of bivariate association of SMM with women's perceived social support, women's living arrangements and other perceived distress event during the postnatal period. For analysis, a perceived stress event during postnatal period was treated as a binary variable ('yes or no') as well as a categorical variable (no; bereavement; serious accident or illness; interpersonal relationship; financial issues/homeless and others – see Chapter 7 for the details about the categories). Results confirmed that neither women's perceived social support nor women's living arrangements were significantly associated with their experience of SMM during labour and birth (p=0.68 and p=0.27, respectively). Other perceived stress event during the postnatal period was also not significantly associated with SMM (p=0.43 and p=0.32 for the binary and the categorical variables, respectively).

Next, logistic regression was conducted to explore the association between social support and other perceived stress during the postnatal period, and PTSD symptoms. Results indicated that women's perceived social support and other perceived stress events during the postnatal period were significantly associated with all three indicators of PTSD symptoms at 6 – 8 weeks postpartum. Women with higher perceived social support were less likely to have PTSD symptoms, while women who had other perceived distress events during the postnatal period had higher odds of having PTSD symptoms. However, there was no significant association between women's living arrangements (i.e. adults living with) and PTSD symptoms, although lower odds of PTSD symptoms were observed in women living with other adults than women living no other adults. Results are summarised in Tables 8.43 to 8.45.

Table 8. 43 Bivariate association between postnatal factors and IES ≥20 on Intrusion subscale

	Frequency	ORs	95%CI	P
Perceived social support				
Continuous: unit= 1 score on SSS	1676	0.95	0.92-0.98	**0.004**
(missing)	(148)			
Living arrangements				***Overall: 0.29***
Single (no any adult)	136	1		
With partner	1437	0.56	0.31-1.01	0.053
With parents/sisters/brothers	133	0.62	0.26-1.49	0.29
With other adults	44	0.61	0.17-2.22	0.45
(missing)	(74)			
Perceived stressful event (binary)				
No	1557	1		
Yes	213	1.86	1.14-3.03	**<0.013**
(missing)	(54)			
Perceived stressful event (5 categories)				
No	1557	1		***Overall: 0.007***
Bereavement	27	2.80	0.95-8.27	0.06
Serious accident or illness	49	0.69	0.16-2.87	0.61
Interpersonal relationship	38	1.90	0.66-5.46	0.24
Financial issues/homeless	40	4.03	1.80-8.99	0.001
Others	59	1.17	1.42-3.30	0.77
(missing)	(54)			
Total	1824			

Table 8. 44 Bivariate association between postnatal factors and IES ≥20 on Avoidance subscale

	Frequency	ORs	95%CI	P
Perceived social support				
Continuous: unit= 1 score on SSS	1676	0.91	0.88-0.93	<0.001
(missing)	(148)			
Living arrangements				***Overall: 0.24***
Single (no any adult)	136	1		
With partner	1451	0.61	0.36-1.06	0.08
With parents/sisters/brothers	134	0.44	0.19-1.07	0.07
With other adults	45	0.68	0.22-2.15	0.51
(missing)	(74)			
Perceived stressful event (binary)				
No	1552	1		
Yes	215	1.77	1.14-2.75	**0.011**
(missing)	(57)			
Perceived stressful event (5 categories)				***Overall: 0.057***
No	1552	1		
Bereavement	28	2.57	0.96-6.88	0.06
Serious accident or illness	49	1.34	0.52-3.45	0.54
Interpersonal relationship	38	1.79	0.69-4.67	0.23
Financial issues/homeless	42	2.78	1.26-6.15	0.011
Others	58	1.12	0.44-2.84	0.82
(missing)	(57)			
Total	1824			

Table 8. 45 Bivariate association between postnatal factors and IES ≥20 on both subscales

	Frequency	ORs	95%CI	P
Perceived social support				
Continuous: unit= 1 score on SSS	1676	0.93	0.89-0.97	**<0.001**
(missing)	(148)			
Living arrangements				***Overall: 0.10***
Single (no any adult)	136	1		
With partner	1437	0.50	0.24-1.04	0.06
With parents/sisters/brothers	133	0.11	0.01-0.86	0.04
With other adults	44	0.67	0.14-3.23	0.62
(missing)	(74)			
Perceived stressful event (binary)				
No	1541	1		
Yes	211	2.54	1.39-4.65	**0.002**
(missing)	(72)			
Perceived stressful event (5 categories)				***Overall: 0.001***
No	1541	1		
Bereavement	27	4.16	1.21-14.31	0.024
Serious accident or illness	49	0.69	0.09-5.13	0.72
Interpersonal relationship	38	0.90	0.12-6.69	0.92
Financial issues/homeless	39	6.04	2.41-15.15	<0.001
Others	58	2.46	0.86-7.09	0.09
(missing)	(72)			
Total	1820			

8.3.3 Multivariable logistic regression analysis

The results of bivariate analysis above showed women's perceived social support, living arrangements and other perceived stress events were neither confounders nor mediators since they were not associated with severe maternal morbidity. However, women's perceived social support and other perceived stress events were strongly associated with PTSD symptoms indicating they might be independent risk factors of PTSD or possible effect modifiers in which the effect of SMM on PTSD symptoms were modified by the level of social support or other stress event during postnatal period.

Logistic regression models were developed to test the joint effect of SMM and women's perceived social support in postnatal period on PTSD symptom, by adding an 'interaction term' (a function of SPSS to evaluate effect modifiers). The results,

however, indicated that there were no significant modification effects either between perceived social support and SMM or between other stress events (p=0.22) and SMM on PTSD symptoms (p=0.35). Therefore, these variables (perceived social support and other perceived stress events) were simply adjusted for their effects with multivariable logistic regression models as independent risk factors of PTSD symptoms.

Table 8.46 shows the results of series of logistic regression models. The first model shows unadjusted odds ratios for the relationship between SMM and the three indicators of PTSD symptoms. In the second model, women's baseline characteristics (age, parity, ethnicity and BMI) were added to adjust for the effects. In the third model women's perceived social support and other perceived distress events were added. For the variable of other perceived stress events, the binary category was used as it consistently showed high significance in the relationship with all three indicators of PTSD symptoms. It also allows the sample size in the subgroups to be larger so that the estimate of the effect size of perceived stress events can be more stable. Results showed that there was the consistent significant relationship between SMM and all three indicators of PTSD symptoms in all models. Results also showed that women's perceived social support was significantly associated with PTSD symptoms, except for the relationship with intrusion symptoms that was no longer significant. The effects of other perceived stress events during the postnatal period on PTSD were no longer significant when women's baseline characteristics were adjusted for. In conclusion, PTSD symptoms were more frequently observed in women with a lower level of perceived social support regardless of their experience of SMM. However, women who had SMM were also more likely to experience PTSD symptoms, regardless of the level of social support or other perceived stress event during the postnatal period.

Table 8. 46 Multivariable logistic regression analysis of the association between SMM and PTSD symptoms adjusted for social support and stress events in postnatal period

		≥20 on IES Intrusion subscales			≥20 on IES Avoidance subscales			≥20 on IES both subscales		
		ORs	**95%CI**	**P**	**ORs**	**95%CI**	**P**	**ORs**	**(95%CI)**	**P**
Model 1	**SMM (unadjusted)**									
	SMM vs. Non-SMM	**2.23**	**(1.27-3.92)**	**0.005**	**3.36**	**(2.16-5.23)**	**<0.001**	**3.07**	**(1.54-6.10)**	**0.001**
Model 2	**SMM**									
	SMM vs. Non-SMM	**2.24**	**(1.24-4.07)**	**0.008**	**3.37**	**(2.09-5.43)**	**<0.001**	**3.09**	**(1.53-6.27)**	0.002
	Age									
	(continuous unit=1 year)	1.02	(0.98-1.06)	0.29	1.00	(0.97-1.04)	0.83	1.03	(0.97-1.08)	0.35
	Parity									
	Multiparity vs. primiparity	0.69	(0.44-1.11)	0.12	0.95	(0.64-1.41)	0.81	0.77	(0.41-1.43)	0.40
	Ethnic groups			*Overall: 0.001*			*Overall: 0.005*			*Overall: 0.001*
	Black vs. White	2.02	(1.22-3.35)	0.006	2.11	(1.37-3.26)	0.001	1.76	(0.87-3.53)	0.12
	Asian vs. White	0.99	(0.41-2.36)	0.98	1.12	(0.56-2.24)	0.75	0.59	(0.14-2.54)	0.48
	Mixed/Other vs. White	3.23	(1.69-6.15)	0.000	1.92	(1.01-3.64)	0.046	4.50	(2.12-9.56)	<0.001
	BMI									
	(continuous unit=1kg/m^2)	1.05	(1.01-1.08)	0.014	1.02	(0.99-1.06)	0.22	1.04	(0.99-1.09)	0.18
Model 3	**SMM**									
	SMM vs. Non-SMM	**2.21**	**(1.24-3.96)**	**0.007**	**3.58**	**(2.20-5.84)**	**<0.001**	**3.23**	**(1.58-6.60)**	**0.001**
	Age									
	(continuous unit=1 year)	1.02	(0.98-1.06)	0.29	1.01	(0.97-1.04)	0.66	1.03	(0.97-1.07)	0.32
	Parity									
	Multiparity vs. primiparity	0.73	(0.46-1.15)	0.17	0.93	(0.63-1.38)	0.72	0.75	(0.40-1.40)	0.36
	Ethnic groups			*Overall: 0.001*			*Overall: 0.049*			*Overall: 0.002*
	Black vs. White	2.13	(1.30-3.49)	0.03	1.76	(1.14-2.74)	0.012	1.52	(0.75-3.08)	0.24
	Asian vs. White	0.73	(0.28-1.87)	0.51	0.93	(0.46-1.89)	0.85	0.50	(0.12-2.18)	0.36
	Mixed/Other vs. White	2.68	(1.41-5.12)	0.03	1.65	(0.86-3.15)	0.13	3.94	(1.84-8.47)	<0.001
	BMI									
	(continuous unit=1kg/m2)	1.04	(1.00-1.08)	0.04	1.01	(0.98-1.05)	0.44	1.03	(0.98-1.08)	0.27
	Perceived social support									
	(continuous: unit=1 score on SSS)	0.97	(0.93-1.00)	0.06	0.91	(0.88-0.94)	<0.001	0.94	(0.90-0.98)	0.009
	Other perceived stress event									
	Yes vs. No	1.61	(0.94-2.77)	0.08	1.24	(0.75-2.03)	0.40	1.87	(0.95-3.69)	0.07

Note: ORs and p-value (unadjusted and adjusted for women's baseline characteristics) might change slightly according to the model as they are calculated where respondents' answers for all other variables included in the model are known.

8.3.3 Summary

The relationship between SMM and PTSD symptoms were consistently significant even taking postnatal factors into account. Results indicated that neither social support nor other perceived stress events during the postnatal period modified the effect of SMM on PTSD symptoms, while women who had a lower level of perceived social support were more likely to get PTSD symptoms.

8.4 Chapter summary

The first part of this chapter examined the relationship between severe maternal morbidity (SMM) and posttraumatic stress disorder (PTSD) symptoms at 6 – 8 weeks postpartum adjusting for women's baseline characteristics as potential confounders. The results indicated that, even after adjusting for maternal age, parity, ethnicity, IMD, education qualification, BMI and mental health history, the statistical significance between SMM and PTSD remained.

The second part of this chapter examined whether the relationship between severe maternal morbidity and PTSD symptoms were mediated though women's perceived control during labour and birth, Apgar scores at five minutes, mode of birth and place of birth while adjusting for women's baseline characteristics (age, parity, ethnicity, BMI). Although higher perceived control during labour and birth, better neonatal outcomes and/or no emergency caesarean birth slightly reduced the effect size of SMM on PTSD symptoms, any mediation effects of these variables were partial. Results consistently showed that there was a direct, statistically significant association between SMM and PTSD symptoms.

The final section of this chapter assessed the association between SMM and PTSD symptoms taking into account social support and other perceived stress events during the postnatal period. Since there was no evidence that social support and other perceived stress events during the postnatal period were effect modifiers, these factors were simply adjusted for. A statistically significant difference between SMM and PTSD symptoms remained even after adjusting for these postnatal variables and women's baseline characteristics (age, parity, ethnicity, BMI).

Chapter 9

Discussion and conclusion

9.1 Introduction

This thesis explored the impact of women's experiences of severe maternal morbidity on their postnatal health. A synthesis of qualitative studies on women's experiences of severe maternal morbidity (Chapter 3) and a narrative review of quantitative studies of the association between severe maternal morbidity (SMM) and post-traumatic stress disorder (PTSD) (Chapter 4) identified a potential link between severe maternal morbidity and poor postnatal outcomes, particularly PTSD symptoms. However, due to the methodological limitations of these studies, the reviews highlighted the need for future work based on a large sample size to prospectively investigate this potential link. The prospective cohort study described in this thesis involved 1824 women who gave birth in a large inner city maternity unit in England to assess the impact of an experience of SMM on their postnatal health, focusing particularly on PTSD symptoms at 6-8 weeks following birth. The specific research objectives were: to obtain data on the prevalence of postnatal PTSD symptoms and other postnatal outcomes; to assess whether there were differences in postnatal PTSD symptoms and other postnatal outcomes between women with and without severe maternal morbidity; and lastly to examine the relationship between SMM and PTSD symptoms, taking into account factors which might influence this relationship.

This chapter discusses the study results (presented in Chapters 6 to 8) and relates these to the research aims, objectives, hypotheses, and previous literature on

severe maternal morbidity, postnatal health and PTSD. The clinical relevance of the findings and implications for practice are also considered.

9.2 Summary of findings

This study found that the prevalence of postnatal PTSD symptoms and other physical and psychological morbidity, based on a sample of women in an urban area in England, was similar to results of previous studies in the UK and other developed countries. The study, for the first time in the UK, showed that there was a higher risk of PTSD symptoms following SMM, and that this appeared to be partially influenced by the condition of the baby following birth, and by women's perceived control during labour and birth. There also appeared to be an independent association between severe maternal morbidity and PTSD symptoms at 6-8 weeks postpartum. In addition, SMM had a statistically significant association with negative physical health outcomes. The study found no evidence, however, of an association with depression and general mental health following birth. The association of SMM with breastfeeding and health care use was inconsistent.

9.3 Prevalence of PTSD symptoms and other physical and psychological outcomes at 6-8 weeks postpartum

The first objective of this thesis was to obtain data on the prevalence of postnatal PTSD symptoms and other physical and psychological outcomes in an urban setting in England, such as depression, general health, breastfeeding practice and healthcare use.

9.3.1 PTSD symptoms

Two thirds of the women in the study (65%) were found to have symptoms of distress, as assessed by the measures used, relating to an event that occurred during labour, birth or immediately after the birth. As the study was not designed to identify which specific event was independently associated, it is not possible to provide information on this. An Australian cohort study by Creedy (1999), however, showed that women experience variations of stress during labour and birth. In Creedy's study, women at six weeks postpartum were asked to describe their lasting memory of giving birth and the one thing they thought about most, as a precursor to the administration of the impact of event scale (IES). Creedy (1999) found that 62.3% of women (n=311 out of 499) indicated that they had experienced negative stressful events. The most commonly expressed event or experience was labour pain (20.8%), followed by fear for their own life or their baby's (17.2%) and pain of obstetric intervention (13.5%). Other stressful events included perceived lack of care by staff or lack of support by partner during labour (around 11%).

Despite the fact that many women in the current study expressed distress related to an event during the birth, the proportion of women who had at least one clinically significant level of PTSD symptom (≥20 on either IES intrusion subscale or avoidance subscale) was 11.5% at 6-8 weeks postpartum, with a prevalence of 6% for intrusion and 8.4% for avoidance. The prevalence of both symptoms (the occurrence of both symptoms at the same time) was only 3.5%, which was similar to the range reported in other studies from developed countries. For example, a review of PTSD following childbirth by Olde et al. (2006) showed that the prevalence of PTSD profile/symptoms following childbirth was estimated to be approximately 3% to 6% at around six weeks postpartum and decreased to around 2% at six months postpartum. There is, however, complexity in the comparison of prevalence

or incidence of PTSD/PTSD symptoms following childbirth due to differences in diagnostic criteria, measurement tools, scoring methods and timings of administration of questionnaires or interviews. The prevalence of a specific trauma exposure also differs in different settings, which can affect the prevalence of PTSD/PTSD symptoms (Antony and Stein 2009). The most comparable studies for this study, on the basis of measurement tools, scoring methods, observation time, and study population, are those of Ayers et al. (2007), Czarnocka and Slade (2000) and Ayers (1999).

Ayers et al. (2007), identified that 5% of women (3 out of 64) who gave birth at a hospital in London had PTSD symptoms at 9 weeks postpartum using the same measurement and the same scoring methods as the current study (scored over the cut-off of 20 for both severe symptoms of intrusion and avoidance subscales measured by the IES), a slightly higher prevalence of PTSD symptoms than reported in the current study. Drawing on a sample of women who had a normal birth and delivered a healthy baby in two hospitals in Sheffield, Czarnocka and Slade (2000) identified that 1.9% of women had clinically significant levels of both intrusion and avoidance, as measured by the IES (≥20). The study also showed that 9.9% of the sample had clinically significant levels of either intrusion or avoidance, with 7.6% reporting intrusion and 4.2% reporting avoidance. The slightly lower rate of PTSD symptoms (≥20 on both subscales) in Czarnocka and Slade's (2000) study is probably explained by the study population which comprised relatively healthy women, and was less diverse in terms of ethnicity than the population sampled in the current study. Furthermore, the relatively small sample size in Ayers et al. (2007) and Czarnocka and Slade (2000) might make the estimated prevalence of PTSD symptoms less precise (sample sizes of these studies were 64 and 264, respectively).

The 3.5% prevalence of severe PTSD symptoms in the current study may be considered small. However, approximately 7,000 births occur annually at the study site, and if these numbers were extrapolated, the estimated annual cases of women with severe PTSD symptoms at 6-8 weeks following childbirth would be around 240 a year at this study site alone. Furthermore, seen in the wider context of the UK, the number of women with severe PTSD symptoms would be even higher. For example, in 2010, there were 723,165 live births in England and Wales (ONS 2011a). If the 3.5% prevalence found in the current study was extrapolated to the 2010 figure for England and Wales, there would be more than 25,300 cases of PTSD symptoms for this year alone, although it should be noted that the study finding may not be generalisable to this wider population (which will be discussed later in this Chapter, Section 9.7.1 and Appendix 21)

Intrusive thoughts and re-experiencing an event may affect women's ability to adapt to motherhood and their relationships with others (Creedy, 1999). The experience of avoidance symptoms during the postnatal period may also impair a mother's ability to talk about and process the trauma, leading to social isolation and not seeking appropriate health services and support (Creedy, 1999), with potential implications for her decisions about infant feeding (Beck 2011; Beck and Watson 2008).

9.3.2 Depression

The prevalence of postnatal depression is well-documented in the literature, although there are varying estimations across studies, ranging from 3% to 25%, reflecting differences in population sampling, timing of assessment, diagnosis criteria (major or minor depression), measurement tools (interview or self-report),

and research design (prospective or retrospective) (Dennis and Hodnett 2007). The current study found that 14% of women scored 13 or more on the EPDS at 6-8 weeks postnatal indicating probable depression. This rate was similar to that in a meta-analysis by O'Hara and Swain (1996) who estimated that, based on 59 studies mainly from high-income countries, the average prevalence rate of postnatal depression was around 13% (95% CI: 12.3-13.4%), with slightly higher rates when measured by self-report assessments such as the EPDS (14%, 95% CI: 13.1-14.9%) versus interview-based measures (12%, 95% CI: 11.3-12.7%).

The prevalence of probable depression in the current study was, however, higher than that in a meta-analysis by Gavin et al. (2005), who reported a point prevalence of 1% to 5.7% in the first 12 months postnatally, with the highest rates at 2 months (5.7%) and 6 months (5.6%). The difference in rates is probably a result of different populations and also due to the fact that Gavin et al. (2005) only included studies where depression was diagnosed according to recognised criteria rather than self-report measures and the review identified only a single study for most of these estimates (NICE 2007a).

Although exploring the comorbidity of depression and PTSD symptoms is beyond the aim of this study, previous studies in the general population suggested that major depression is the most common form of posttraumatic psychopathology (NICE, 2005, Rosen and Frueh 2010). In the current study, the proportion of women who had both depression and PTSD symptoms was 1.6%[27] (figure not presented in Results).

[27] Of women who had a risk of depression (EPDS≥13), 12.3% had severe PTSD symptoms (≥20 on both IES intrusion and avoidance subscales). Of women who had severe PTSD symptoms, 47.5% had the risk of depression.

9.3.3 General well-being

This study measured women's general well-being at 6-8 weeks postpartum using the SF-12. Women reported lower (poorer) health compared with US female age-standardised population norms both on the physical and mental components of the SF-12, except for women aged 24 years or younger, where a higher score of mental health (better mental health) was observed in this study than that of the US female population norm. There are a limited number of UK population-based studies that have collected data on postnatal women's general well-being using either the SF36 or the SF12. In a cluster randomised controlled trial of protocol-based, midwifery-led care focused on individual women's physical and psychological health needs in the West Midlands Health Region, MacArthur et al. (2003) presented the mean scores of PCS-36 and MCS-36 among women in the intervention (n=1087) and control (n=977) groups at four and twelve months postpartum. Given that the SF-12 summary scores and SF-36 summary scores are almost identical (Jenkinson et al. 1997a), the score of mental well-being (48.0) in the current study was similar to the control score at four months postpartum in MacArthur et al. (47.5).

The mean physical summary score (48.8) was slightly higher in this study but still showed less than a one-point score difference when compared to the controls at four months in MacArthur (47.9). Differences in population and timing of administration of questionnaires brings into question the comparability of these studies; nevertheless, overall physical and mental well-being generally appeared to be lower among the postnatal population versus the general female age-adjusted population. This may be because women in the postnatal period are emotionally or psychologically vulnerable as they are recovering from childbirth and adjusting to the process of becoming a parent. However, in an Australian cohort study, which examined nulliparous women's health in early pregnancy, Gartland et al. (2010) also

reported significantly poorer health outcomes among pregnant women on almost all domains of the SF-36 compared with age- and gender-standardised population norms. Gartland et al. (2010) argued, “it is likely that women interpreted the scale items regarding general health as referring to their health before pregnancy, as these items did not specify a time period.” A similar issue (no specific time period may affect women’s answer) was identified in the present study during the cognitive interview conducted as a pilot study as described in Chapter 5 (Section 5.6). Moreover, reviewing earlier randomised controlled trials of interventions during the postnatal period which aimed to improve women's health but failed to demonstrate any difference in study outcomes between groups with and without intervention (e.g. Morrell et al. 2000; Reid et al. 1999), Bick (2002) pointed out that it is possible that the outcome measure used by the PCS in SF-36 may not be sensitive enough to detect alteration in postnatal health status. The same issue may arise for the SF-12 as indicated by the low internal consistency reliability of the scale in the current study measured by Cronbach's alpha.

9.3.4 Health care use

The findings of the current study that 97% of women were visited by midwives at home after birth and 88% of women had up to 4 home visits by midwives were very similar to the National Maternity Survey data collated for the same maternity unit in the same year as this study, which showed that, of 239 participants, 97% were visited by midwives at home and 86% were visited up to 4 times (Quality Health 2010). However, the average number of midwifery home visits during the postnatal period in this study (mean=2.7) was less than the national average (mean=3.8) (Redshaw and Heikkila 2010). The reduced frequency of visits by midwives appeared to be associated with unmet needs of women at the study site. Although the current study did not include questions related to women’s perceptions of

postnatal care, the interpretation of unmet needs is supported by the findings of the National Maternity Survey 2010 (Care Quality Commission 2010) which showed that the percentage of women who wanted to see a midwife more often after birth was 38% at the study site (an increase from 33% in 2007); this was significantly higher than the national average of 22%. Moreover, in response to the question "if you contacted a midwife or health visitor, were you given the help you needed?", the percentage of women who answered "yes always" was 52% at the study site which was lower than the national average (75%). The findings of the National Maternity Survey concluded that issues relating to care at home after the birth at the study site were less positive in comparison to other maternity units in the UK (Quality Health 2010). However, the survey results (both in this unit and national) highlighted the continued overall reduction in the number of postnatal home visits made by midwives (Care Quality Commission 2010; Healthcare Commission 2007).

9.3.5 Breast feeding practice

The study finding that 52% of women were exclusively breastfeeding their babies at 6-8 weeks postpartum was much higher than rates reported by the UK wide Infant Feeding Survey (Bolling et al. 2007), which found that in 2005, 21% of mothers in the UK were breastfeeding exclusively at six weeks. The difference in rates can be explained by the fact that the prevalence of exclusive breastfeeding in the Infant Feeding Survey 2005 was defined as "the proportion of all babies who have only ever been given breast milk up to specific ages and who have never been fed, solid foods, or any other liquids," while the rate in this study is the proportion of women who provided only breast milk to their babies at 6-8 weeks postpartum, without giving formula milk. This number is therefore likely to include women who may have fed formula milk until feeding on breast milk was established.

9.3.6 Summary

A range of women's health issues was identified at the time when they were discharged from maternity care. The rate of postnatal health outcomes, particular PTSD symptoms and depression, in the current studies were similar to other UK studies. This suggests that the study results are more likely to be generalisable to other UK settings with similar characteristics of women where similar level and quality of health care service are available.

9.4 Differences in postnatal outcomes between women with and without severe maternal morbidity (SMM)

It has been acknowledged that most people who have experienced even the most harrowing of traumatic experiences do not develop PTSD or any other posttraumatic psychiatric disorder (Rosen and Frueh 2010). Rosen and Frueh (2010) argued that this does not mean that people remain unaffected by traumatic experiences. On the contrary, the majority are likely to experience at least short-term distress following a traumatic event. Nevertheless, only a minority of individuals among those who were exposed to traumatic events develop PTSD symptoms or clinically significant level of PTSD symptoms. It is therefore important scientifically and clinically to identify the characteristics of stressors as well as other factors that contribute to an adverse or positive outcomes (Rosen and Frueh 2010).

The second objective of this thesis, which was to assess whether there were differences in postnatal postraumatic stress disorder (PTSD) symptoms and other physical and psychological outcomes between women with and without severe obstetric morbidity, was based on the assumption that SMM is the stressor that contributes to PTSD symptoms and other adverse outcomes during the postnatal

period. The hypothesis, “women who experience SMM during labour and birth and immediately after birth are more likely to experience PTSD symptoms and other health issues at 6-8 weeks postpartum, compared to those without SMM,” was supported, in part, as statistically significant differences were not observed in all indicators of postnatal health selected in this study.

9.4.1 SMM and PTSD symptoms

Supporting the hypothesis, this study showed that PTSD symptoms were more frequently observed in women who experienced SMM (defined as major obstetric haemorrhage, severe pre-eclampsia/eclampsia/HELLP syndrome and/or HDU admission).

The study finding that the prevalence of PTSD symptoms was higher among women with severe pre-eclampsia/eclampsia/HELLP syndrome than those without reiterates the findings of previous studies conducted in the Netherlands (e.g. Engelhard et al. 2002; Hoedjes et al. 2011). The prevalence of PTSD symptoms (a score of 20 or more on the IES, both intrusion and avoidance) among women with severe PET/eclampsia/HELLP syndrome in the current study (18%) was similar to the prevalence of PTSD profile amongst women with these conditions within 2 years of giving birth as reported by Engelhard et al. (2002) (28% for preterm pre-eclampsia and 17% for the term pre-eclampsia group), but higher than that in the study by Hoedjes et al. (2011), who reported 11% of women with severe pre-eclampsia and HELLP syndrome to have PTSD symptoms at 6 and 12 weeks postpartum. The prevalence of PTSD symptoms in the current study was, however, much lower than the prevalence reported by Baecke et al. (2009) (44% among preterm pre-eclampsia at 6-18 months postpartum). The differences in prevalence of PTSD symptoms between the present study and that of previous studies might be

attributed to the different populations and assessment times, as well as variations in measurement tools and cut-offs used to define the cases of PTSD profile/PTSD symptoms or criteria used to define severe pre-eclampsia. However, the key message from the current study and previous studies appears to be consistent: PTSD profile/symptoms are potentially higher among women who experienced severe hypertensive disorder than women with medically uncomplicated pregnancies.

The study finding that the proportion of women with PTSD symptoms increased with an increase in the severity of obstetric haemorrhage categories is reported for the first time here. For example, Ayers (1999) found no correlation between the amount of blood loss and PTSD symptoms in the UK population (Ayers 1999). However, as mentioned earlier (Chapter 4), the range of blood loss was not reported in Ayers' study, nor the definition of blood loss (eg. postnatal, vaginal), and it is uncertain if there were any cases of severe obstetric haemorrhage in her study.

The findings of the current study also contrasted with Thompson et al. (2011b), who studied postnatal morbidity following severe postpartum haemorrhage (PPH) in Australia. The definition of significant PPH in Thompson et al. (2011b) included “estimated blood loss of 1500 ml or more in the first 24 h” (p.365-6). This is similar to the current study in which major obstetric haemorrhage was defined as an estimated blood loss volume greater than 1500ml (either vaginal birth or caesarean section (CS) related), or having a transfusion of four or more units of blood. While the current study found a prevalence of PTSD symptoms of 8.6% for women with major obstetric haemorrhage and 2.6% for women with an estimated blood loss less than 500 ml, the prevalence of PTSD profile for women with severe PPH in Thompson et al. (2011) (measured with a PCL>44) was found to be 5% (n=9 out of

171) at two months and 3% (n=5 out of 167) at four months, which, they believed, were higher than expected but still within the anticipated range. From this finding, Thompson et al. concluded, "[in] women experiencing significant PPH, outcomes were better than expected, providing some reassurance for clinicians. Some of the important ingredients of good clinical care may already be in place" (p.370). Thompson et al's. (2011b) study was, however, a descriptive study, as there was no comparison group and potential confounders were not controlled for. Although the prevalence of PTSD profile in their study was similar to the results in a previous review by Olde et al. (2006) and a Nigerian study by Adewuya et al. (2006), these studies included women who suffered from PPH and were conducted in different settings, therefore may not be comparable.

No previous quantitative studies have examined PTSD symptoms among women admitted to the HDU or ICU following birth, but the results of this study, that women with HDU admission were more likely to have PTSD symptoms, supports qualitative work based on interviews undertaken by Souza et al. (2009), as described in Chapter 3.

Although the current study had a number of limitations (e.g., use of self-report measures, potential non-response bias), which will be described later, it does provide evidence that in an inner city area of England, rates of PTSD symptoms at 6-8 weeks postpartum were higher amongst women who experienced major obstetric haemorrhage, severe hypertensive disorder and/or HDU admission.

9.4.2 SMM and depression

There was no significant difference in postnatal depression (score of 13 or above on the Edinburgh Postnatal Depression Scale: EPDS) between women with SMM (any

type of SMM) and those without. This result is consistent with a previous matched cohort study of severe maternal morbidity conducted with women (331 cases and 1339 controls) in the same region (Waterstone et al. 2003). Using a cut-off score of 13 on the EPDS, Waterstone et al. (2003) found that the proportions of women who were at risk of postnatal depression were not significantly different between cases of SMM and the control group, although their non-parametric (Mann–Whitney) analysis showed that the median EPDS scores were significantly higher in the cases than in the controls (median 7 for controls, 9 for cases) – the scores were still below threshold and difference in median scores may be clinically negligible, despite statistical significance.

The results of the current study also support previous studies by Engelhard et al. (2002) and Baecke et al. (2009), who found that the proportion of women who suffered from clinical levels of depression (measured by the Beck Depression Inventory (BDI) within 2 years and at 6-18 months postpartum, respectively) was not statistically different after term pre-eclampsia, pre-term pre-eclampsia, pre-term birth without complications, and uneventful term birth. Conversely, these studies showed statistically significant differences in the proportion of PTSD profile/symptoms between these groups as described earlier.

The results of the current study do differ from a study in USA by Burger et al. (1993) who found that women with a severe pregnancy complication were significantly more likely to report postpartum depression than those without a complication. There were, however, a number of methodological limitations in Burger et al's (1993) study and it is difficult to confirm the link between pregnancy complication and postnatal depression. Firstly, the presence of postpartum depression was confirmed by women's report of "feeling blue, sad, or depressed months after

delivery" (p.567), and the use of a specific validated question was not described. Secondly, information on women's experience of severe pregnancy complications was collected by self-report during the postnatal period, which is therefore subject to information and recall bias. In addition, the definition of severe pregnancy complication was not clearly described but included various types of complication such as premature birth and diabetes.

Thus, in studies, which used clear definitions of severe maternal morbidity and validated measures of postnatal depression, there is no evidence of a relationship between severe maternal morbidity and postnatal depression. This may be because, unlike PTSD, in which there is almost always a precipitating event that leads to it (Rachman et al. 2004), depression often occurs without having a specific trigger. This is reflected in the Diagnostic and Statistical Manual (DSM), in which PTSD is described as one of only a few mental disorders for which there is a known cause. In contrast "a diagnosis of depression opens the issue of causation to many factors other than the stated cause of action" (Sparr 2007, p.297).

9.4.3 SMM and general health (SF-12)

The current study consistently showed that women who experienced SMM had significantly poorer physical health outcomes as measured by SF-12 at 6-8 weeks postpartum than women without SMM, except for women with severe hypertensive disorder. The small number of women who had severe hypertensive disorder meant that statistical significance could not be detected, but there was a trend of a decrease in the median scores of the physical health component of the PCH-12 (indicating poorer physical health outcomes) with an increase in severity of hypertensive disorder groups. On the other hand, mental health status as measured by the SF-12 was similar between women with and without SMM (any type of

SMM). These results are in line with the findings of Waterstone et al. (2003), who found that, at six months post-partum, women with severe maternal morbidity scored worse in every category of the SF-36 than those who had an uncomplicated pregnancy and birth, but one of the smallest differences was in the mental health score component.

The current study's results, however, differed from Thompson et al's (2011b) study, which measured general health outcomes using the SF-36 and concluded that emotional and physical health outcomes among women with severe PPH were similar to those reported in general postnatal populations. These findings should be interpreted with caution, though, as the study compared results with the control group in Waterstone et al. (2003), which again raises the question of comparability. The studies were conducted in different settings, and Waterstone et al. (2003) were clear about the limitations of their control group, saying, "our control population was not 'normal' as it included women with minor and moderate morbidity and the study was not set up to examine these" (p.132).

The observation of non-significant differences in mental well-being between women with and without SMM is most likely due to the fact that, as with depression, mental well-being is affected by various factors rather than having a single event as its determinant. Alternatively, SF-12 may not be sensitive enough to detect the general well-being issues including mental health in a postnatal population as discussed earlier.

Since the current study did not include questions to identify physical problems specific to postnatal women, there is a limitation in examining the reasons for significant differences in physical well-being between women with and without SMM.

However, in a study on health outcomes after significant primary PPH by Thompson et al. (2011b), women reported various types of physical health issues at two and four months postpartum, including physical exhaustion, constipation, backache, pain at site of caesarean incision, and perineal pain. Thompson et al. (2011) did not have healthy "controls'" in their study, so it is difficult to draw a conclusion, but there is a possibility that women with SMM are more likely to experience physical health issues than those without SMM.

9.4.4 SMM and health care use

Overall, there were no significant differences between women with and without SMM (any type of SMM) in terms of the number of visits by midwives and health visitors during the 6-8 week postnatal period. However, the average number of visits by health visitors was significantly higher in women with HDU admission than those without (1.55 and 1.36, respectively), indicating better response from health visitors than midwives for women with HDU admission. The difference between these groups was, however, very small, which raises the question of whether the difference was clinically meaningful, despite being statistically significant.

Women who had major obstetric haemorrhage (estimated blood loss: EBL ≥1500 or blood transfusion of 4 units or more) were less likely to visit their GP for a 6-8 week postnatal check. However, they were more likely to visit health professionals, apart from the 6-8 week general postnatal check, than women who did not have major obstetric haemorrhage. Women who had experienced major obstetric haemorrhage were more likely to visit their GP (other than for a 6-8 week postnatal check) and other health professionals such as accident and emergency or walk-in clinics during the first 6-8 weeks postnatal. The most frequently reported reason for their visits was related to wound problems as a result of CS birth or episiotomy, followed by

issues of breastfeeding. As major obstetric haemorrhage is often associated with caesarean birth and serious perineal tears, these appeared to contribute to a higher use of health services before a routine 6-8 week postnatal check. Women with HDU admission were also likely to visit health care professionals more than those who were not admitted. The most frequently reported reason, again, was wound issues. This is understandable, as the number of women with major obstetric haemorrhage and HDU admission overlap.

9.4.5 SMM and breastfeeding

In the current study, there were no statistically significant differences in exclusive breastfeeding practice at 6-8 weeks postpartum between women with or without SMM, except for women with hypertensive disorder. Rates of exclusive breastfeeding at 6-8 weeks postpartum significantly decreased with the increase in severity of a hypertensive disorder. While 53% of women with non-hypertensive disorder were breastfeeding (only breastfeeding without adding formula milk) at 6-8 weeks postpartum, the corresponding figures were 36% and less than 27% for women with hypertension/PET and women with severe PET/eclampsia/HELLP syndrome, respectively. On the contrary, the proportion of women who had never breastfed their baby significantly increased with severity of hypertensive disorder (5%, 6% and 18% for women with non-hypertensive disorder, hypertension/PET and severe PET/eclampsia/HELLP, respectively). This result may be related to the babies' condition such as NICU or SCBU admission as babies are more likely to be compromised premature with severe cases of hypertensive disorders. This result also may reflect the fact that some women with hypertensive disorders in pregnancy were receiving antihypertensive treatment in the postnatal period. Following the NICE clinical guideline on *hypertension in pregnancy: the management of hypertensive disorders during pregnancy hypertension* (NICE 2010), these women

might be advised against breastfeeding by clinician as, for most drugs to date, “there is insufficient evidence on the safety in babies receiving breast milk” (NICE 2010, p.32).

There was no significant difference between the three obstetric haemorrhage groups in the proportion of women who had either exclusively breastfed or never breastfed. Despite no statistical significance, the proportion of women who had never breastfed was higher for those with major obstetric haemorrhage (8.2%), compared to women with no haemorrhage or mild obstetric haemorrhage (4.8% for both groups). Few studies to date have examined breastfeeding practice following SMM. In an earlier study on women's breastfeeding experiences following a significant primary postpartum haemorrhage, Thompson et al. (2010) found that the overall rate of exclusive breastfeeding was 63% in the first postpartum week, 58% at two months postpartum and 45% at four months postpartum of women with significant PPH (EBL ≥ 1500 ml etc.). The study also reported that breastfeeding rates were lowest at all time points for women with the highest estimated blood loss (EBL > 3000 ml) when compared to the rest of the groups (EBL < 2000; EBL: 2000-2999). However, comparing the EBL < 2000 ml group to the EBL: 2000-2999 ml group, the rate of exclusive breastfeeding was almost similar or slightly higher for the EBL 2000-2999 ml group at two and four months, although lower rates were observed for the EBL 2000-2999 group at one week postpartum, indicating that among women with estimated blood loss of 2000-2999 ml, there was some recovery in terms of ability to exclusively breastfeed by two months postpartum. Thompson argued that there are numerous factors that could affect the delay in breastfeeding initiation and subsequent difficulties for the mother in establishing full breastfeeding, such as separation from the infant and maternal exhaustion, but “even if full breastfeeding cannot be established immediately, there is the prospect of doing so

later, and this offers potential for interventions to support and encourage women to continue breastfeeding following a significant PPH despite early difficulties" (p.10).

Various factors might have influenced breastfeeding practice among women in the current study, which showed no significant difference between women with and without SMM at 6-8 weeks postpartum. Some women with SMM might have changed their feeding practice from partial to exclusive in the supportive environment, although further examination of possible factors that contributed to the results is beyond the aim of this study.

9.4.6 Summary

The results discussed in this section were based on bivariate analyses, which did not control for any potential cofounders. Nevertheless, in the absence of other studies or with very few studies having examined the impact of SMM to date, the results still provide important information on subsequent potential impact on health of women and their babies.

9.5 Relationship between SMM and PTSD symptoms

The third objective of this thesis was to examine the relationship between SMM and PTSD symptoms, taking into account factors that might influence the association. The study results consistently showed a significant relationship between SMM and PTSD even after adjusting for women's baseline characterises (age, parity, ethnicity, educational qualifications, index of multiple deprivation, pre-pregnancy BMI and mental health history). These study findings supported the hypothesis that an independent relationship exists between SMM and PTSD.

This study also examined whether the relationship between SMM and PTSD symptoms was mediated by maternal perceptions of control during labour and birth, neonatal outcomes, obstetric intervention and place of birth. The results confirmed that higher perceived control and better neonatal outcomes had a protective effect on PTSD symptoms following severe maternal morbidity. However, there was insufficient or inconsistent evidence to demonstrate whether the mode of birth and place of birth had mediator effects on the relationship between SMM and PTSD. This may be because psychological impacts of medical interventions or place of birth following SMM depends on many other factors such as professional behaviour and manner at the time of the emergency (Mapp and Hudson 2005; McCourt et al. 2011). The key findings from the mediation analyses were, however, that any mediation effects were partial and SMM directly contributed to PTSD symptoms.

Finally, this study examined the relationship between SMM and PTSD symptoms, taking into account social support and an experience of other perceived stressful events during the postnatal period. The results showed that social support and perceived stressor during postnatal period were neither confounder nor mediators, as they were not related to women's experience of severe maternal morbidity and the proportion of severe maternal morbidly was similar across women with different levels of social support and those with or without other stress events during the postnatal period. These postnatal factors were also not effect modifiers; in other words, the effect size of severe maternal morbidity on PTSD symptoms was similar across women with different level of perceived support and those with and without other perceived stressors. However, in line with earlier studies (Slade 2006), this study found that women's lower perceived social support was associated with increased risk of PTSD symptoms, implying that this is an independent risk factor for PTSD symptoms.

The association between PTSD symptoms and women's perceptions of lower social support, however, should be interpreted with caution. Data on these two issues were obtained simultaneously, and it could also be the case that low perceived social support was a consequence of PTSD symptoms. Women with PTSD symptoms may require more support and some women may feel they lack enough support. Fewer postnatal visits in the area might also contribute to lower perceived social supports among women who suffer PTSD symptoms following their birth. Further discussion regarding the predictors of PTSD is beyond the scope of this study since the objective of the analysis discussed here was to examine the relationship between SMM and PTSD symptoms.

In summary, the finding of this study clearly showed that there is a direct association between severe maternal morbidity and PTSD symptoms even taking into account numbers of factors that might influence the relationship as confounders, mediators and effect modifiers.

9.6 Contribution to knowledge

Study of the impact of severe maternal morbidly is relatively new, and the current study added evidence of the relationship between women's experience of SMM and the risk of PTSD symptoms at six to eight weeks postpartum. The finding was obtained by overcoming a number of methodological limitations identified in previous studies on PTSD symptoms following childbirth. In previous studies, small sample size was a common issue. Due to the small sample size, the association between SMM and PTSD was often investigated by exploring differences in the mean score of the self-reported measurement of PTSD symptoms between the risk

and non-risk groups. Therefore, interpretation of the result was difficult because statistical significance in the mean score of self-report measurement does not necessarily mean clinical significance. Since the current study had a large sample size, it was possible to compare the probability of having a clinically significant level of PTSD symptoms between women with and without SMM. Moreover, in this prospective study, women's experience of SMM was identified through clinical records, which could minimise recall bias. An additional strength of this study, compared to the previous studies, was that the variables that were potentially on the causal pathway between SMM and PTSD symptoms, such as women's perceived control during labour and birth and poor neonatal outcomes, were not treated as confounders. Instead, the effects of these variables on the association between SMM and PTSD symptoms were presented as potential mediators. This was important because in many previous studies, these variables were simply adjusted for and by doing so the potential effect of SMM was also eliminated, which Katz (2006a) calls "overadjustment" (p.76).

This study also identified the possibility of reduced physical health status among women with severe maternal morbidity. There might also be a potential impact upon child health and future maternal health as shown in the significantly lower breastfeeding practice in women with severe pre-eclampsia/eclampsia/HELLP syndrome, as well as a higher rate of non-routine health service use following birth among women with major obstetric haemorrhage and those who are admitted to the High Dependency Unit (HDU). Further study is required to confirm the adverse effect of SMM on these postnatal aspects.

9.7 Study strengths and limitations

9.7.1 Generalisability and representativeness of the study sample

The study results were obtained with a large sample in a tertiary hospital in the diverse locality where many languages are spoken. Due to resource limitations, the study excluded women who were unable to read and understand English. The study also excluded women under 16 years of age and those who had a stillbirth or neonatal death with ethical considerations. The numbers of these women were small, but it is possible that postnatal health issues were underestimated as a result of excluding potentially high-risk groups.

Among eligible women, the response rate was 53%[28]. Although this rate is considered low in general, responses to women's surveys in this region were lower, for example, as shown in the national maternity survey undertaken in this Trust, which had a 51% response rate (Care Quality Commission 2010; Quality Health 2010). Given the context, the response rate in the current study would be acceptable.

The study sample was not representative of the study population in terms of women's demographic characteristics. Respondents were older, more likely to be primiparous, of white ethnicity and living in less-deprived areas compared to non-participants. However, surveys demand literacy, engagement and organisation, and previous studies, Care Quality Commission (2010) and Waterstone et al. (2003) have also found it difficult to engage women from younger age groups, poorer areas or different ethnicities in their research. The characteristics of birth were similar

[28] This is the rate excluding 55 women who could not be contacted by postal mail from the denominator. The response rate is 52%, if it is calculated based on women who participated in the study (n=1824) out of all eligible women (n=3510).

between the two groups, except for the mode of birth, which was statistically significantly different with more instrumental and fewer spontaneous vaginal births (SVD) in respondents than non-respondents. The rates of caesarean birth (either elective or emergency) were however similar between respondents and non-respondents with only 1 % difference between the groups.

In terms of the level of severe maternal morbidity, the rates of major obstetric haemorrhage were very similar between respondents and non-respondents with no statistically significant difference. The rates of other indicators of severe maternal morbidity were not comparable due to the small numbers of cases (eclampsia, HELLP syndrome, ICU admission) and a lack of reliable data available for non-participants (HDU admission). However, because major obstetric haemorrhage was the most common form of severe maternal morbidity, the current study sample appeared to be relatively representative in terms of severe maternal morbidity in the study population.

Considering how the response rate might have biased results, there is a potential risk of the underestimation of PTSD symptoms and other physical and psychological problems during the postnatal period due to the lower response from more vulnerable groups and also because women with PTSD symptoms and/or depression might be less likely to respond. However, because the sample was relatively representative in terms of severe maternal morbidity, the results of the significant association between SMM and PTSD were less likely to be affected as none of the indicators for demographic characteristics of women in this study were acting as potential confounders.

The demographic and birth characteristics of the study sample and their levels of severe maternal morbidity were also compared with those of women in England and/or the UK, where data for these were available. Compared to the national cohort of women, study participants were again older and had achieved higher educational attainment. The catchment area of the study hospital is one of the most deprived geographical areas in England (Southwark Analytical Hub 2008), and so study participants were living in a more deprived area compared to the national average (although they were relatively less deprived compared to non-participants in this study). Similarly, reflected by the study area, they were more diverse ethnically compared to other regions of England. In terms of the level of severe maternal morbidity, it was representative for major obstetric haemorrhage. However it was not possible to compare rates of other types of severe maternal morbidity because of the small numbers involved the current study sample and/or lack of national data available for comparison. Further details of the comparison of sample characteristics with those of women in England and the UK are described in Appendix 21. The current study results are therefore only generalisable to the population with similar demographic and obstetric characteristics of women.

9.7.2 Limitation and strength of scales used in data collection

Postnatal outcomes were collected using a self-administered questionnaire. Although the scales used in the study were carefully selected, with published accounts of their validity and reliability taken into consideration, some of the scales (IES to measure PTSD symptoms and SF-12 to measure general health status) were not specifically developed for postnatal populations. Selecting a scale for PTSD symptoms was particularly difficult as it was the primary outcome of interest, but there were no validated self-report scales specifically for postnatal population.

While the IES is considered to have some disadvantages since it only measures two of the three PTSD symptoms, (intrusion and avoidance but not hyperarousal), excluding hyperarousal was considered to be advantageous, as it is a potentially normal adoptive adjustment following the birth of a baby (Slade 2006). Nevertheless, from this study, the identification of true cases of PTSD was not possible.

Reliability of all scales selected for this study was also tested in the current study sample through examining internal consistency. Cronbach's Alpha showed good internal consistency reliability for almost all scales except for SF-12, which had low internal consistency (α=0.37 for PHC and α=0.26 for MHC). While the results provided further evidence for the reliability of almost all scales used in this study, measuring general health for postnatal women using SF-12 may raise issues as discussed in Chapter 5 (section 5.5.5.3).

A self-administered questionnaire may also have disadvantages compared to an interview, as respondents are more likely to skip some questions or misinterpret the question in absence of the researcher who, otherwise, would be able to clarify any misunderstanding (Polit and Beck 2008). In order to minimize the response error, cognitive interviews were conducted prior to the main study, which helped to improve the clarity of questions in the questionnaire.

Another important issue identified through the process of data collection was that there were some instances of missing data in clinical records. The records were sometimes inconsistent with information provided by clinical staff (ie. numbers of cases of severe cases of hypertensive disorder, blood transfusion) or monthly reports by the Trust. When there was inconsistency, further investigation was made seeking help from clinical staff with access to other data sources (HDU admission

notes, blood transfusion records). Despite such efforts, there is a possibility that some cases of severe maternal morbidity were not identified and they were misplaced in the categories of no severe maternal morbidity cases.

This study included the women's mental health histories as collected from maternity booking records. However, the low rates of recorded mental health history indicated potential underreporting, under detecting, or under recording. This study also did not specifically ask women about trauma experiences from previous births. Ehlers and Clark (2000) argued that individuals with PTSD symptoms might suffer intrusive and distressing memories of past experiences triggered by the current stress event, during which time the individual confused the past stress with present circumstances (Bryant 2010). Including information on the history of traumatic birth experience for multiparous women could have been informative.

9.7.3 Challenge for analysis

The analysis followed the original plan outlined in Chapter 5 but some issues arose. The main issue of concern was the limitations of mediator analysis. Mediation analysis was conducted based on the assumption that SMM might affect PTSD symptoms through mode of delivery, neonatal outcomes, and/or women's perceived control during labour and birth. However, in general, the direction of the relationship between SMM and the mode of delivery could go either way (i.e., the mode of delivery might be pre-selected according to the presence of SMM or SMM might occur because of the mode of delivery). If the latter is the case, the mode of delivery could be a confounder rather than a mediator. Because confounders and mediators are statistically very similar, it was not possible to determine the true mechanism of the relationship between SMM and PTSD symptoms from this study. However, the statistical significance between SMM and PTSD remained the same regardless of

inclusion of mediator variables in the model or not. Therefore, misplacing the variable is unlikely to have affected the study results.

Another limitation is that women's perceived control during labour and birth and women's perceived social support were measured postnatally, and it is again difficult to apportion cause and effect. There is a possibility that significant association of these variables with PTSD symptoms might be attributable to recall bias in which women with PTSD symptoms were more likely to remember their perception of loss of control, recalling their feelings of fear, helplessness, and/or being uncared for during labour and birth. Similarly, women with PTSD might have felt a lack of support because they needed more support than those who had no PTSD symptoms. If this is the case, it would be incorrect to include these variables in logistic regression models. The results of multivariable logistic regression analysis with and without these variables, however, did not change the significant association between SMM and PTSD symptoms indicating that the study results were unlikely to be affected.

9.8 Implications for policy and practice

Despite the limitations stated above the results of the current study highlight a numbers of implications for policy and practice.

9.8.1 Increasing awareness

It is important to raise awareness about the impact of SMM amongst women, clinicians and policy makers in order for every mother to have "the best possible start with her new baby and for the change in her life and responsibilities" (RCOG, 2008, p.36). Studies have shown that while there is an increased trend towards

SMM, the numbers of postnatal visits for individual women by midwives and health visitors have been continuously decreasing (Care Quality Commission 2010) due to the rising birth rate (ONS 2011a) and the requirement to save £20 billion through NHS budgets (Department of Health 2011). In such an era, raising awareness of the association between SMM and PTSD symptoms is particularly important for preventing and managing SMM and its subsequent issues, and maximising use of finite resources.

9.8.2 Antenatal and intrapartum care

It is important to ensure the safety and quality of maternal care in order to prevent, manage and treat SMM. Although some cases of SMM may occur unexpectedly, the UK Confidential Enquiries into Maternal Death have continuously highlighted the issues of substandard care in the management of obstetric haemorrhage and hypertensive disorders, which have contributed to maternal death in some cases. The major causes of substandard care that have remained unchanged over years include failure of communication between healthcare workers (e.g. GPs not being consulted about further referral or the GP not passing on information relevant to the woman's health and well-being), a lack of senior support and backup for junior trainees and midwives who are on the front line attending women in emergencies and a lack of clinical knowledge and skills among clinicians (CMACE 2011).

The RCOG (2008) guidelines on *Standards for maternity care* clearly stated the importance of multidisciplinary, high-quality teamwork with identified care pathways for referral. Effective systems of communication between the individual members of an interdisciplinary health care team are also essential. Following recommendations by CMACE (2011) and the RCOG (2009b) guidelines on *Responsibility of Consultant on-Call*, the individual responsibilities of clinical team members should

be clearly defined to prevent and manage SMM. Training on how to communicate information in an effective, efficient and sensitive manner should therefore be provided to all healthcare professionals RCOG (2008). Improving clinical knowledge and skills for early recognition and taking prompt action on the signs and symptoms of potentially life-threatening conditions is also crucial, as is improving the quality of clinical reports to assess the quality of care (CMACE 2011; RCOG 2009b).

The current study also found that a high level of women's perceived control over self and environment during labour and birth might potentially reduce the effect of SMM on PTSD symptoms. It is acknowledged that the birth environment influences the birthing experience; less clinical, non-threatening and more 'home-like' environment is less stressful and creates more feeling of control for women with fewer complications (RCOG 2008). More studies are required to establish what interventions would increase the level of perceived control among women who are facing severe maternal morbidity. However, the results of the synthesis of qualitative studies in the current thesis on the impact of severe maternal morbidity found that women appeared to feel more in control, even in an emergency, when they were informed about treatment options and when they were involved in decision-making whenever possible. In line with the RCOG (2008) guideline on *Standards for Maternity Care*, even in emergency scenarios, it is important to communicate well with women and their partners; respecting their views and providing information and opportunity for them to fully understand the reason for medical treatment. In addition, as the NICE (2007b) guidance *on Intrapartum care* already recommends, receiving enough support in labour from clinical staff and the birth partners of their choice is critical. This may also make a difference in the level of perceived control over self and environment during labour and birth and subsequent impact on PTSD symptoms.

9.8.3 Postnatal care

It is critical to minimise the adverse impact of SMM on maternal and child health by providing individualised postnatal care, which is planned with women with consideration of relevant factors from the antenatal, intrapartum, and immediate postnatal period (NICE 2006).

In the UK, postnatal care ends at 6–8 weeks following birth based on the assumption that women would have physically and psychologically recovered from giving birth by that time. However, there is a lack of evidence to support the timing as well as contents of postnatal care (Bick 2010; Byrom et al. 2010). Earlier observational studies from the UK and Australia also highlighted that women experienced a wide range of maternal physical and psychological health problems, many of which persisted beyond the postnatal period (Brown and Lumley 1998; Walsh and Downe 2005). The studies also reported that these "health problems were unlikely to be identified within routine postnatal care, as women did not report them and health professionals did not ask about them" (Bick 2010, p.30). The current study also identified a range of health issues, including PTSD symptoms, at the time women were discharged from maternity care.

In the current system of postnatal care, PTSD symptoms are particularly difficult to identify because PTSD following birth is still a rather new concept and is not currently being screened for by midwives and practitioners. In addition, a timely and appropriate treatment for PTSD symptoms may not be provided to women due to the frequent misuse of the term 'postnatal depression' by health professionals as a label for any mental illness occurring postnatally (Lewis and Drife 2004). Women may also not report the symptoms, even if they experience them because they may

be frightened of being labelled as a ‘bad mother’, or they may not even be aware of the necessity of professional support when they experience such symptoms.

Following the NICE (2006) guidelines on postnatal care, women with SMM should be offered relevant information to recognise the signs of possible postnatal health problems that they may experience, including PTSD symptoms. The guideline also highlighted the importance of offering an opportunity for women to talk about their birth experiences and to ask questions about the care they received during labour. These are crucial for women who had SMM as they tend to expect health professionals to help them to make sense of their experience of severe maternal morbidity and the care they received to manage the condition (Mapp 2005; Thompson et al. 2011a).

Specific implications for clinical practice could include providing extra information, at the time of discharge, about signs and symptoms of PTSD to women who experienced SMM, and also about emotional support available to those who suffer from these symptoms. It would enable women to recognise the signs and symptoms of PTSD symptoms early and seek appropriate help. This might also help women to recognise these symptoms as an understandable adaptation to their experience of SMM, so that rather than fearing that their responses might be perceived as evidence of poor coping by health care professionals, women would recognise the significance of their symptoms and be more willing to come forward for treatment.

9.8.4 Current practice in PTSD treatment

The NICE (2005) guidance on PTSD clearly stated that signs of PTSD symptoms following a traumatic event should be monitored over time to make sure problems are identified at a very early point and to provide appropriate and effective care to

meet individual need. The guideline also suggested the importance of screening for people who require further and more detailed assessment. The finding of the link between SMM and PTSD in the current study is therefore important as it gives “the opportunity to focus on individuals at high risk of PTSD and to contribute to the development of specific intervention”, in line with the NICE guideline (NICE, 2005, p.93).

The current treatment to reduce symptoms of PTSD and other traumatic related problems has been outlined by the International Society of Traumatic Stress Studies (Foa et al. 2009) who suggests that the main form of treatment is trauma-focused cognitive behavioural therapies (Rosen and Frueh 2010). This kind of treatment has be found to be effective and has also been recommended by NICE guidelines on PTSD who have stated that “trauma-focus cognitive-behavioural therapy should be offered to people who present with PTSD within 3 months of a traumatic event.” (p.92). There is also evidence that, in many cases, comorbid problems that are secondary to the PTSD, such as depression, improve with successful trauma-focused psychological treatment. Therefore it is recommended that when a patient presents with PTSD and depression, health care professionals should consider treating the PTSD first, although there are numbers of exceptions in which depression should be treated first (NICE 2005). Early recognition of women at risk and appropriate referral is necessary, as this reduces the duration of treatment and potentially reduces subsequent long term burden of PTSD both on the individual and society (NICE 2005). These guidelines are developed for adults in the general population, and a Cochrane systematic review on the effective intervention for preventing psychological trauma in women following childbirth is currently being undertaken (Bastos et al. 2008).

More research is needed about what care should be included during the postnatal period to minimise the adverse impact of SMM, but earlier cluster randomised controlled trials in the UK (MacArthur et al. 2002; MacArthur et al. 2003) demonstrated positive psychological outcomes (measured by EPDS and the mental health component score in SF-36) among women who received a new model of midwifery-led postnatal care which included planned midwife visits, symptom checklists at 10 and 28 days, guidelines for management, midwifery care extended to include a final check at 10–12 weeks, compared to the current model of care. MacArthur et al.'s study (2002, 2003) also found that this new model of care was cost-effective since health outcomes were improved but the costs remained similar. These results indicate that planned and tailored midwifery-led postnatal care might benefit women who had SMM.

9.9 Future research

This study focused on the early postnatal period. Longer-term follow-up studies are necessary to understand comprehensive health issues and the recovery process following SMM. More research is also needed to consider what care should be included during the postnatal period to minimise the impact of SMM as well as analyses of the cost-effectiveness of the proposed care.

9.10 Conclusion

Despite the concern about recent increases in the incidence of severe maternal morbidity little was known about the impact of severe maternal morbidity on women following birth. This thesis explored the impact of women's experiences of severe maternal morbidity on their postnatal health at 6-8 weeks by conducting a

prospective cohort study of women who gave birth in a large urban maternity unit in England. Results showed that women experienced a range of postnatal health issues including PTSD symptoms, at the time they were discharged from maternity care. There was a higher risk of PTSD symptoms among women who experienced severe maternal morbidity, compared to women who did not have severe maternal morbidity. The study also identified the possibility of other postnatal physical health issues, which appeared to increase the need for non-routine visits to healthcare professionals during the postnatal period. Safety and quality maternity care and the continuum of care from acute to primary care are critical. In addition, if care is tailored appropriately to meet individual women's needs, postnatal health issues would be identified and acted upon appropriately.

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Appendix

Appendix 1. ICD-10 code for PPH in NHS Information Centre

NHS
Connecting for Health

NHS Classifications Service

CLINICAL CODING QUERY RESOLUTION

CLINICAL CODING QUERY DETAILS
Helpdesk Query Ref No: 591883 (Please quote on all correspondence related to this query)
Summary Key Term: Postpartum haemorrhage

IMPORTANT INFORMATION

Helpdesk responses are provided in response to an individual query when provided with supporting documentation related to an individual patient's particular condition and treatment. As a result the response from the helpdesk is not transferable and is specific to only the scenario presented in the original query. NHS Connecting for Health cannot accept responsibility when resolutions provided have been shared as the resolution applies only to the circumstances originally presented.

Only resolutions provided officially by the NHS Classifications Service National Clinical Classifications Helpdesk can be considered correct in meeting current national clinical coding/classification standards in use in the NHS.

RESOLUTION TO QUERY

Thank you for your query.

Clinical coding is the translation of medical terminology documented in the patient care record by the clinician (or other medical professionals involved in the patient's care) into a coded format in order to describe a patient's complaint, problem, diagnosis, treatment or reason for seeking medical attention.

We can confirm that it is not the responsibility of the clinical coder to interpret the clinical information for the levels of blood loss when assigning ICD-10 codes. Any clinical diagnosis of postpartum haemorrhage (classified at the category **O72.- Postpartum haemorrhage**) by a midwife or obstetrician must be coded as such, irrespective of the amount of blood loss. Also, the documented amount of blood loss should never be used as an assumption of postpartum haemorrhage. This condition should only be coded if this is clearly documented within the patient record. If there is any doubt as to the diagnosis of postpartum haemorrhage, it is recommended that the clinical coder always seeks clinical advice for further guidance.

National Clinical Classifications Helpdesk
NHS Classifications Service
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References include:

WHO International Classification of Diseases and Health Related Problems – Tenth Revision Volume 1, 2 and 3 - Reprinted (with updates and corrections) 2000. Reprinted 2001, 2004
OPCS Classification of Surgical Operations and Procedures Version 4.6, Volume 1 and 2
NHS Clinical Coding Instruction Manual (ICD-10 and OPCS-4)
Coding Clinic guidance

Appendix 2. A synthesis of qualitative studies - excluded studies and the reason for the exclusion

Assessed the experience of the clinical management to prevent SMM
BARLOW, J. H., HAINSWORTH, J. & THORNTON, S. 2008. Women's experiences of hospitalisation with hypertension during pregnancy: feeling a fraud. Journal of Reproductive and Infant Psychology, 26, 157-167.
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RICHTER, M., PARKES, C. & CHAW-KANT, J. 2007. Listening to the voices of hospitalized high-risk antepartum patients. Journal of Obstetric, Gynecologic, and Neonatal Nursing, 36, 313-318.
Not assessed women's experience of SMM
ERLANDSSON, K., LINDGREN, H., MALM, M. C., DAVIDSSON-BREMBORG, A. & RADESTAD, I. 2011. Mothers' experiences of the time after the diagnosis of an intrauterine death until the induction of the delivery: A qualitative Internet-based study. Journal of Obstetrics and Gynaecology Research, 37, 1677-1684.
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Severe maternal morbidity not analysed separately
BECK, C. & WATSON, S. 2010. Subsequent childbirth after a previous traumatic birth. Nursing Research, 59, 241-249.
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MANDEL, D. 2010. The lived experience of pregnancy complications in single older women, MCN The American Journal of Maternal/Child Nursing. 35 (6) (pp 336-340), 2010. Date of Publication: November-December 2010.
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THOMAS, H. 2004. Women's postnatal experience following a medically complicated pregnancy. Health Care for Women International, 25, 76-87.
Participants only selected from those who had a particular postnatal outcomes
BECK, C. T. 2004. Post-traumatic stress disorder due to childbirth: the aftermath. Nursing Research, 53, 216-24.
Unsupported by raw data
THEROUX, R. 2007. Listening to women's pregnancy and postpartum experiences: two qualitative studies. Nursing for Women's Health, 11, 503-5.
VAN PAMPUS, M. G., WOLF, H., WEIJMAR SCHULTZ, W. C. M., NEELEMAN, J. & AARNOUDSE, J. G. 2004. Posttraumatic stress disorder following pre-eclampsia and HELLP syndrome. Journal of Psychosomatic Obstetrics & Gynecology, 25, 183-7.
Quantitative data obtained using open ended questions on survey
THOMPSON, J. F., FORD, J. B., RAYNES-GREENOW, C. H., ROBERTS, C. L. and ELLWOOD, D. A. 2011a. Women's experiences of care and their concerns and needs following a significant primary postpartum hemorrhage. Birth-Issues in Perinatal Care, 38, 327-335.
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Quantitative studies
BURGER, J., HORWITZ, S. M., FORSYTH, B. W., LEVENTHAL, J. M. & LEAF, P. J. 1993. Psychological sequelae of medical complications during pregnancy. Pediatrics, 91, 566-71.

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Irrelevant population
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Reviews on 'traumtaic birth'
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Appendix 3. A synthesis of qualitative studies - synopses of the selected studies

Paper 1: Carvalheira et al. (2010)

A total of 16 women who experienced various types of severe maternal morbidity were interviewed to gain insight on severe maternal morbidity from the perspective of women who experienced it. Interviews were individually carried out in a room at the hospital after discharge. Using the Collective Subject Discourse, four themes were identified: 'describing the desire and plan for having a child; acknowledging the health problem and its influence on pregnancy and on the conceptus; overcoming the initial shock postpartum; and experiencing the risk situation: desires, frustration, and overcoming' (p.1187).

Paper 2: Elmir et al. (2012)

This study described women's experiences of having an emergency hysterectomy following a severe postpartum haemorrhage. After recruitment via media release, posters, and flyers, a total of 21 Australian women participated in the study. The median age of participants at the time of interview was 42 years (range: 24 to 57 years), and the median years since having the hysterectomy was 4 years (range: 5 weeks to 28 years). Data was generated though semi-structured tape-recorded interviews. Interview method options were provided to women (face-to-face, telephone, or internet email interview). Data was inductively analysed. A major theme which emerged was 'between life and death', with three sub-themes, 'being close to death: bleeding and fear', 'having a hysterectomy: devastation and realisation', and 'reliving the trauma: flashbacks and memories'.

Paper 2: Engstrom and Lindberg (2012)

This Swedish study described women's experiences during and after a complicated birth and a stay in an ICU. A total of 8 women were interviewed at their home or the researchers' work office at between one and half and three months postnatal. With thematic content analysis, the study identified one theme; "wishing to be in control and together as a family" and six categories under the theme; "being or not being prepared, feeling afraid, not being as ill as the others, knowing about the baby, worrying about the father and having someone to talk to" (p.66).

Paper 4: Jonkers et al. (2011)

This study explored 'ethnicity-related factors contributing to sub-standard maternity care and the effects on severe maternal morbidity (severe pre-eclampsia, postpartum haemorrhage, hysterectomy) among immigrant women in the Netherlands'. In the study, 40 immigrant and 10 native Dutch women were interviewed between two and six weeks after discharge from

hospital and asked ‘about their perspectives on the development of their medical complication and on the received health care, with particular attention to self-diagnosis, health care seeking behaviour, presentation of complaints, recognition of complaints by health care providers, and communication with them’ (p.145). Obstetricians were invited to this study to compare the immigrant women’s perspectives with their physicians' perspectives, as obtained from the medical files. A thematic analysis was then applied which ‘focused on the question of where things went wrong, what health care providers did wrong, and why and how things went wrong from the women’s perspectives’ (p.145). Using the method of grounded theory, a number of sensitising concepts emerged such as ‘the nature

Paper 5: Kidner and Flanders-Stepans (2004)

This US study adopted a grounded theory methodology to explore the experiences of women who had HELLP syndrome. A total of nine women were recruited from an online support group for patients with HELLP syndrome and interviewed via telephone. The study described the essential structure of the experience of HELLP syndrome using “a circle of no control and not knowing, which included the five themes of premonition, symptoms, betrayal, whirlwind, and loss” (p.44).

Paper 6: Mapp and Hudson (2005)

Using a phenomenological methodology, this study explored “women’s ‘lived experiences’ of specific obstetric emergencies”. Ten women were recruited from a NHS Trust in the UK, of whom, one woman had eclampsia and seven women had severe postpartum haemorrhage (blood loss ≥ 1500mls). Face-to-face interviews were conducted at the interviewees’ homes or in hospital (the option were given to women). Data were analysed following Colaizzi’s method. Main themes identified included “issues around communication both verbal and non-verbal and the need to make sense of what had happened to them” (p.30).

Paper 7: Mapp (2005)

This is the second part of the study on women’s experience of emergency obstetric complication by Mapp and Hudson (2005) focusing on the postnatal consequences following the obstetric complication. The authors highlighted the issues of ‘shell shock’ after the event and the lack of information given by their GP at six-week postnatal check regarding their experiences of obstetric emergencies.

Paper 8: McCain and Deatrick (1994)

This study explored the experiences of 12 women who had high-risk pregnancy and pre-term birth, and those of their husbands. The study setting was not clearly stated but it appeared to be conducted in the US. Although high-risk pregnancy included a numbers of pregnancy complications, which were not considered as severe maternal morbidity (eg.

premature rupture of membranes), the study did have a separate section which included women's experience of eclampsia. It was therefore considered relevant to the current synthesis.

Paper 9: Souza et al. (2009)

This study explored the experience of 30 women, recruited from a public university hospital in Sao Paulo, Brazil, who were admitted to the ICU due to severe maternal morbidity. Semi-directed interviews were conducted in a private room by a trained female interviewer during a participant's hospitalization but close to hospital discharge. Using thematic analysis, two major themes were identified, 'one more closely related to the experience of a critical illness and the other to the experience of care' (p.149). The study contributes to the current synthesis by providing a deep understanding about women's emotional reactions to severe maternal morbidity. This study also provided the potential positive impact of women's experience of severe maternal morbidity on their lives.

Appendix 4. A systematic narrative review - excluded studies and the reason for the exclusion

Table A - 1

No variable of maternal morbidity
AHLUND, S., CLARKE, P., HILL, J. & THALANGE, N. K. S. 2009. Post-traumatic stress symptoms in mothers of very low birth weight infants 2-3 years post-partum. *Archives of Womens Mental Health,* 12**,** 261-264.
ALLEN, S. F. C. 1996. *An investigation of post-traumatic stress disorder symptoms following traumatic labour experiences : causal factors, mediating variables and consequences. [electronic resource].* Thesis (Ph.D.), University of Southampton.
ANDERSON, C. & LOGAN, D. 2010. Impact of traumatic birth experience on Latina adolescent mothers. *Issues Ment Health Nurs,* 31**,** 700-7.
AYERS, S., HARRIS, R., SAWYER, A., PARFITT, Y. & FORD, E. 2009. *Posttraumatic stress disorder after childbirth: Analysis of symptom presentation and sampling*, Journal of Affective Disorders. 119 (1-3) (pp 200-204), 2009. Date of Publication: January 2009.
AYERS, S. & PICKERING, A. D. 2001. Do women get posttraumatic stress disorder as a result of childbirth? A prospective study of incidence. *Birth-Issues in Perinatal Care,* 28**,** 111-118.
BAILHAM, D. 2001. *Psychological trauma following childbirth. [electronic resource].* Thesis (Ph.D.), University of Warwick.
CZARNOCKA, J. & SLADE, P. 2000. Prevalence and predictors of post-traumatic stress symptoms following childbirth. *British Journal of Clinical Psychology,* 39**,** 35-51.
DAVIES, J., SLADE, P., WRIGHT, I. & STEWART, P. 2008. *Posttraumatic stress symptoms following childbirth and mothers' perceptions of their infants*, Infant Mental Health Journal. 29 (6) (pp 537-554), 2008. Date of Publication: 2008.
DAVIS, L., EDWARDS, H., MOHAY, H. & WOLLIN, J. 2003. The impact of very premature birth on the psychological health of mothers. *Early Human Development,* 73**,** 61-70.
DEMIER, R. L., HYNAN, M. T., HARRIS, H. B. & MANNIELLO, R. L. 1996. Perinatal stressors as predictors of symptoms of posttraumatic stress in mothers of infants at high risk. *Journal of Perinatology,* 16**,** 276-80.
DENIS, A., PARANT, O. & CALLAHAN, S. 2011. *Post-traumatic stress disorder related to birth: A prospective longitudinal study in a French population*, Journal of Reproductive and Infant Psychology. 29 (2) (pp 125-135), 2011. Date of Publication: April 2011.
ELHAI, J. D., FRUEH, B. C., GOLD, P. B., HAMNER, M. B. & GOLD, S. N. 2003. Posttraumatic Stress, Depression and Dissociation as Predictors of MMPI-2 Scale 8 Scores in Combat Veterans with PTSD. *Journal of Trauma & Dissociation,* 4**,** 51-64.
ELKLIT, A., HARTVIG, T. & CHRISTIANSEN, M. 2007. *Psychological sequelae in parents of extreme low and very low birth weight infants*, Journal of Clinical Psychology in Medical Settings. 14 (3) (pp 238-247), 2007. Date of Publication: Sep 2007.
FAIRBROTHER, N. & WOODY, S. R. 2007. Fear of childbirth and obstetrical events as predictors of postnatal symptoms of depression and post-traumatic stress disorder. *Journal of Psychosomatic Obstetrics & Gynecology,* 28**,** 239-42.
FEELEY, N., ZELKOWITZ, P., CORMIER, C., CHARBONNEAU, L., LACROIX, A. & PAPAGEORGIOU, A. 2011. Posttraumatic stress among mothers of very low birthweight infants at 6 months after discharge from the neonatal intensive care unit. *Applied Nursing Research,* 24**,** 114-7.
FORD, E., AYERS, S. & BRADLEY, R. 2010. Exploration of a cognitive model to predict post-traumatic stress symptoms following childbirth. *Journal of Anxiety Disorders,* 24**,** 353-9.
GAMBLE, J., CREEDY, D., MOYLE, W., WEBSTER, J., MCALLISTER, M. & DICKSON, P. 2005. Effectiveness of a counseling intervention after a traumatic childbirth: a randomized controlled trial. *Birth (Berkeley, Calif.)* [Online]. Available:http://www.mrw.interscience.wiley.com/cochrane/clcentral/articles/141/CN-00513141/frame.html.
HOLDITCH-DAVIS, D., BARTLETT, T. R., BLICKMAN, A. L. & MILES, M. S. 2003. *Posttraumatic stress symptoms in mothers of premature infants*, Journal of obstetric, gynecologic, and neonatal nursing : JOGNN / NAACOG. 32 (2) (pp 161-171), 2003. Date of Publication: 2003 Mar-Apr.
ILES, J., SLADE, P. & SPIBY, H. 2011. *Posttraumatic stress symptoms and postpartum depression in couples after childbirth: The role of partner support and attachment*, Journal of Anxiety Disorders. 25 (4) (pp 520-530), 2011. Date of Publication: May 2011.
KEOGH, E., AYERS, S. & FRANCIS, H. 2002. Does anxiety sensitivity predict post-traumatic stress symptoms following childbirth? A preliminary report. *Cognitive Behaviour Therapy,* 31**,** 145-155.
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SODERQUIST, J., WIJMA, B. & WIJMA, K. 2006. The longitudinal course of post-traumatic stress after childbirth. *Journal of Psychosomatic Obstetrics & Gynecology,* 27**,** 113-9.
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BALLARD, C. G., STANLEY, A. K. & BROCKINGTON, I. F. 1995. Post-traumatic stress disorder (PTSD) after childbirth. *British Journal of Psychiatry,* 166**,** 525-8. CARTY, S. 2007. *Trauma following childbirth [electronic resource].* Thesis (Clin.Psy.D), University of Birmingham 2007. FONES, C. 1996. Posttraumatic stress disorder occurring after painful childbirth. *Journal of Nervous & Mental Disease,* 184**,** 195-6. REYNOLDS, J. L. 1997. Post-traumatic stress disorder after childbirth: the phenomenon of traumatic birth. *CMAJ Canadian Medical Association Journal,* 156**,** 831-5. VAN PAMPUS, M. G., WOLF, H., WEIJMAR SCHULTZ, W. C. M., NEELEMAN, J. & AARNOUDSE, J. G. 2004. Posttraumatic stress disorder following pre-eclampsia and HELLP syndrome. *Journal of Psychosomatic Obstetrics & Gynecology,* 25**,** 183-7.
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CLEMENT, S. 2001. Psychological aspects of caesarean section. *Best Practice & Research in Clinical Obstetrics & Gynaecology,* 15**,** 109-26.
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OLDE, E., VAN DER HART, O., KLEBER, R. & VAN SON, M. 2006. Posttraumatic stress following childbirth: A review. *Clinical Psychology Review,* 26**,** 1-16.
ROSS, L. E. & MCLEAN, L. M. 2006. Anxiety disorders during pregnancy and the postpartum period: A systematic review. *Journal of Clinical Psychiatry,* 67**,** 1285-98.
SAWYER, A., AYERS, S. & SMITH, H. 2010. Pre- and postnatal psychological wellbeing in Africa: a systematic review. *Journal of Affective Disorders,* 123**,** 17-29.
STONE, H. L. 2009. Post-traumatic stress disorder in postpartum patients: what nurses can do. *Nursing for Women's Health,* 13**,** 284-91.
TEDSTONE, J. E. & TARRIER, N. 2003. Posttraumatic stress disorder following medical illness and treatment. *Clinical Psychology Review,* 23**,** 409-48.

The same study (published or non-published)

CREEDY, D. K., SHOCHET, I. M. & HORSFALL, J. 2000. Childbirth and the development of acute trauma symptoms: Incidence and contributing factors. *Birth-Issues in Perinatal Care,* 27**,** 104-111.

Appendix 5. Ethics approval and R&D approval

COPY FOR YOUR INFORMATION

NHS

National Research Ethics Service

Camden & Islington Community Research Ethics Committee
REC Offices
South House, Royal Free Hospital
Pond Street, London
NW3 2QG

Telephone: 020 7794 0500 extn 36906
Facsimile: 020 7794 1004

22 March 2010

Professor Debra Bick
Professor of Evidence Based Midwifery, KCL
4th Floor, James Clark Maxwell Building
57 Waterloo Road
London
SE1 8WA

Dear Professor Bick

Study Title: **Women's health after having a baby: Exploring the experience of adverse obstetric events on maternal psycho-social and physical morbidity and wellbeing within 6 weeks of birth**

REC reference number: **10/H0722/15**
Protocol number: **1**

Thank you for your letter of 11 March 2010, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to

the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk. *Where the only involvement of the NHS organisation is as a Participant Identification Centre, management permission for research is not required but the R&D office should be notified of the study. Guidance should be sought from the R&D office where necessary.*

Sponsors are not required to notify the Committee of approvals from host organisations.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Covering Letter		04 February 2010
REC application		
Protocol	1	30 January 2010
Investigator CV	C.I.s CV - Debra Bick	03 February 2010
Participant Information Sheet	1	02 February 2010
Participant Consent Form	1	04 January 2010
Letter from Statistician	Peter Milligan, KCL	29 January 2010
Referees or other scientific critique report		
Summary/Synopsis	Version 1	20 January 2010
Student CV	Student's CV - Marie Furuta	02 February 2010
Opt-Out Letter	1	04 January 2010
Questionnaire: Draft	1	02 February 2010
Letter - Questionnaire	1	04 January 2010
Letter for GP	1	04 January 2010
Letter for Postnatal Midwife	1	04 January 2010
Follow-Up Letter	1	04 January 2010
Evidence of insurance or indemnity	Zurich Municipal for KCL	31 July 2009
Participant Information Sheet	Version 2	05 March 2010
Opt-Out Letter	Version 2	09 March 2010
Response to Request for Further Information	Cover letter from Marie Furuta	11 March 2010

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Service website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

10/H0722/15	**Please quote this number on all correspondence**

Yours sincerely

pp **Ms Stephanie Ellis**
Chair

Email: katherine.ouseley@royalfree.nhs.uk

Enclosures: *"After ethical review – guidance for researchers"*

Copy to: *Student - Miss Marie Furuta*

Sponsor's contact – Keith Brennan, KCL

Co-Sponsor and R&D contact for NHS care organisation at lead site – Karen Ignatian, Guy's & St. Thomas' Hospital NHS Trust

Guy's and St Thomas' NHS
NHS Foundation Trust

Research & Development
Guy's & St Thomas' Foundation NHS Trust
16th Floor Tower Wing
Guy's Hospital
St Thomas Street
London SE1 9RT
Tel: 02071885731

Professor Debra Bick
Professor of Evidence Based Midwifery
RM, BA, MMedSc, PhD
King's College London
4th Floor
James Clark Maxwell Building
57 Waterloo Road, London
SE1 8WA

13 May 2010

Dear Professor Bick,

Title: Women's health after having a baby: Exploring the experience of adverse obstetric events on maternal psychosocial and physical morbidity and wellbeing within 6 weeks of birth

In accordance with the Department of Health's Research Governance Framework for Health and Social Care, all research projects taking place within the Trust must receive a favourable opinion from an ethics committee and approval from the Department of Research and Development (R&D) prior to commencement.

- **Ethics number: 10/H0722/015**
- **Sponsor: KCL**
- **Funder: N/A**
- **End date: 31/01/2012**
- **Protocol: Version 1**
- **Site: GSTFT**
- **R&D approval Date: 13/05/2010**

R&D have reviewed the documentation submitted for this project and I am pleased to inform you that we are approving the work to proceed within Guy's and St Thomas' NHS Foundation Trust and has been allocated the Trust R&D registration number RJ1 10/N108 Please quote the R&D registration number in any communications with the R&D Department regarding your project.

Conditions of Approval:

- The principal investigator must notify R&D of the actual end date of the project.
- The Principal Investigator is responsible for ensuring that Data Protection procedures are observed throughout the course of the project.
- The project must follow the agreed protocol and be conducted in accordance with all Trust Policies and Procedures especially those relating to research and data management.
- R&D must be notified of any changes to the protocol prior to implementation.
- Please submit a copy of the progress report on the anniversary of the Ethics favourable opinion **(March)**

If appropriate it is recommended that you register with the Current Controlled Trials website; http://isrctn.org/

Please ensure that you are aware of your responsibilities in relation to The Data Protection Act 1998, NHS Confidentiality Code of Practice, NHS Caldicott Report and Caldicott Guardians, the Human Tissue Act 2004, Good Clinical Practice, the NHS Research Governance Framework for

Health and Social Care, Second Edition April 2005 and any further legislation released during the time of this study.
Members of the research team must have appropriate substantive or honorary contracts with the Trust prior to the study commencing. Any additional researchers who join the study at a later stage must also hold a suitable contract.

If the project is a clinical trial under the European Union Clinical Trials Directive the following must also be complied with:

1. The EU Directive on Clinical Trials (Directive 2001/20/EC) and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Regulations 2004;
2. The EU Directive on Principles and Guidelines for Good Clinical Practice (EU Commission Directive 2005/28/EC); and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Amendment Regulations 2006;

Amendments
Please ensure that you submit a copy of any amendments made to this study to the R&D Department.

Annual Report
It is obligatory that an annual report is submitted by the Chief Investigator to the research ethics committee, and we ask that a copy is sent to the R&D Department. The yearly period commences from the date of receiving a favourable opinion from the ethics committee.

Should you require any further information please do not hesitate to contact us.

In line with the Research Governance Framework, your project may be randomly selected for monitoring for compliance against the standards set out in the Framework. For information, the Trust's process for the monitoring of projects and the associated guidance is available from the Trust's intranet or on request from the R&D Department. You will be notified by the R&D Department if and when your project has been selected as part of the monitoring process. No action is needed until that time.

Many thanks for registering your research project

Yours Sincerely,

Maria Briana
R&D Governance Coordinator

cc. Chief Investigator
cc. Sponsor

NHS

National Research Ethics Service

North West London REC 1

REC Office
Maternity, Level 7
Northwick Park Hospital
Watford Road
Harrow
HA1 3UJ

Tel: 020 8869 5446
Fax: 020 8869 5222

25 November 2010

Professor Debra Bick
Professor of Evidence Based Midwifery
4th Floor
James Clark Maxwell Building
57 Waterloo Road, London
SE1 8WA

Dear Professor Bick

Study title:	**Women's health after having a baby: Exploring the experience of adverse obstetric events on maternal psycho-social and physical morbidity and wellbeing within 6 weeks of birth**
REC reference:	**10/H0722/15**
Protocol number:	**N/A**
Amendment number:	**Substantial Amendment 2**
Amendment date:	**20 October 2010**

The above amendment was reviewed on 24 November 2010 by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

Approved documents

The documents reviewed and approved at the meeting were:

Document	Version	Date
Protocol	2	20 October 2010
Notice of Substantial Amendment (non-CTIMPs)	Substantial Amendment 2	20 October 2010
Covering Letter	Letter to Ms Ellis from Ms Furuta	25 October 2010

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

R&D approval

All investigators and research collaborators in the NHS should notify the R&D office for the relevant NHS care organisation of this amendment and check whether it affects R&D approval of the research.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

10/H0722/15:	**Please quote this number on all correspondence**

Yours sincerely

Louise Braley

Ms Louise Braley
Committee Co-ordinator

E-mail: louise.braley@nhs.net

Enclosures: *List of names and professions of members who took part in the review*

Copy to: *Keith Brennan, King's College London*

North West London REC 1

Attendance at Sub-Committee of the REC meeting on 24 November 2010

Written comments received from:

Name	*Position*
Ms Heidi Chandler	PA/Administrator
Ms Stephanie Ellis	Former Civil Servant

Appendix 6. Data sources and definitions of variables

Variables	Definition/criteria/classification	Type of variable	Data source
Age	Maternal age at delivery	Continuous Categorical	Clinical record (maternity records)
Parity	The number of previous deliveries after 24 weeks of gestational age http://www.patient.co.uk	Discrete Categorical	Clinical record (maternity records)
Ethnic groups	Self-defined genetic ethnicity, classified according to the Office for National Statistics (ONS) country specific ethnic group classification in England Office for National Statistics (ONS) country specific ethnic group classification in England (ONS 2011, http://www.ons.gov.uk/ons/guide-method/measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html	Categorical 1'White' 2'Black' 3'Asian' 4'Mixed/Multiple ethnic groups' 5'other ethnic groups'	Clinical record (maternity records)
Index of Multiple Deprivation (IMD)	An overall measure of multiple deprivation experienced by people living in an area. A relative ranking of areas is calculated according to the English Indices of Deprivation (2010) http://www.communities.gov.uk/documents/statistics/pdf/1871208.pdf	Ordinal 1 'least deprived' 2 'fourth' 3 'third' 4 'second' 5 'most deprived'	Clinical record (postcode)
Educational level	Highest qualification women attained. Qualification categories are based on the UK education system and used in the Office for National Statistics report http://www.ons.gov.uk/ons/dcp171776_229888.pdf http://www.direct.gov.uk/en/EducationAndLearning/QualificationsExplained/index.htm	Categorical 1 'None' 2 'GCSE level (CSE or O Level or equivalent)' 3' A Level or equivalent' 4 'Degree or equivalent (or above)'	Postnatal questionnaire
Living arrange-ments	Adult living together at 6-8 weeks postpartum	Categorical 1 'None' 2 'Husband/partner' 3 'Parents/sister/brothers' 4 'Other'	Postnatal questionnaire
BMI	Maternal pre-pregnancy BMI=weight (kg) / [height (m) x height (m)] Categories are based on NICE (2005)	Continuous Ordinary 1'<18.5' 2 '18.5-24.9' 3 '25.0-29.9' 4 '30.0-34.9' 5 '35.0-39.9' 6 '≥40.0'	Clinical record (maternity records)
Mental health history	Self-reported depressive symptoms, mental illness, family history of mental illness prior and during pregnancy • 'Felt down, depressed or hopeless' and/or "little interest or pleasure in doing things in the past month • Schizophrenia, bipolar affective disorder or any other psychotic illness • Severe depression requiring treatment by a mental health service • Postpartum psychotic illness (for multiparous) • Inpatient or outpatient treatment by a psychiatrist or mental health team • Family history of severe mental illness in the postnatal period or family history of bipolar affective disorder (manic depression)	Binary 1 'no' 2 'mental illness history'	Clinical record (maternity records)

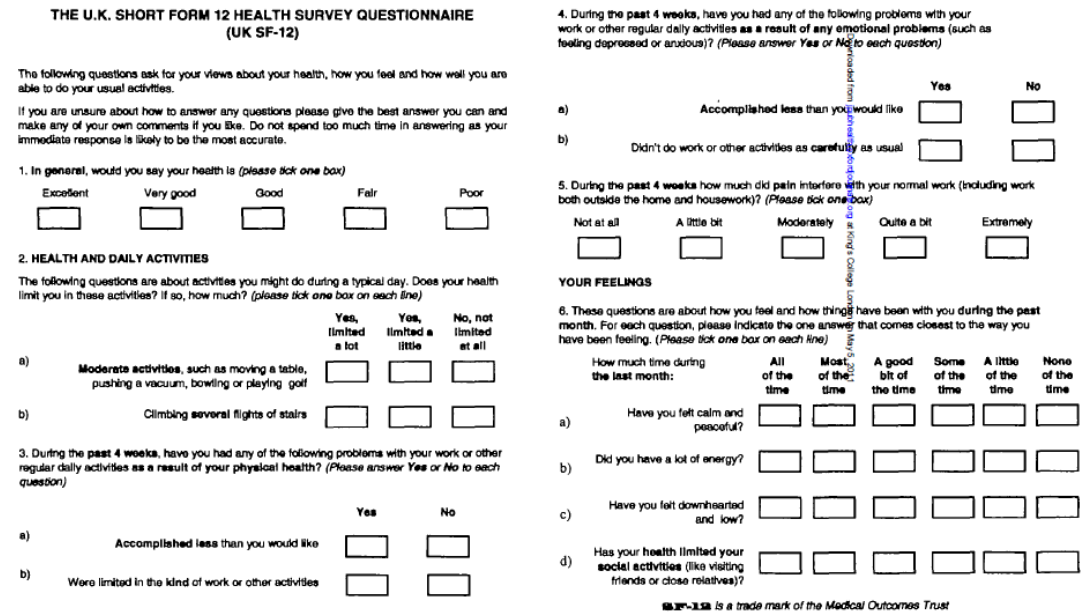
Variables	Definition/criteria/classification	Type of variable	Data source
Place of birth	Obstetric unit (OU): "an NHS clinical location in which care is provided by a team, with obstetricians taking primary professional responsibility for women at high risk of complications during labour and birth. Midwives offer care to all women in an OU, whether or not they are considered at high or low risk, and take primary responsibility for women with straightforward pregnancies during labour and birth. Diagnostic and treatment medical services including obstetric, neonatal and anaesthetic care are available on site, 24 hours a day" (Rowe 2011, p.12). Alongside midwifery unit (AMU): "an NHS clinical location offering care to women with straightforward pregnancies during labour and birth in which midwives take primary professional responsibility for care. During labour and birth diagnostic and treatment medical services, including obstetric, neonatal and anaesthetic care are available, should they be needed, in the same building, or in a separate building on the same site. Transfer will normally be by trolley, bed or wheelchair" (Rowe 2011, p.12). Home birth: birth at home (planned) carried out by a team of community midwives (staff in the hospital) Birth before arriving hospital (BBA): this includes birth at Accident and Emergency (A&E) department, unplanned home birth, in an ambulance or public place etc.	Categorical 1 'Obstetric unit' 2 'AMU' 3 'Home birth' 4 'BBA'	Clinical record (maternity records)
Mode of delivery	Spontaneous vaginal delivery (SVD): spontaneous vaginal delivery for cephalic presentation Breech extraction: assisted vaginal delivery for breech presentation Instrumental delivery: forceps and ventouse Elective caesarean section: C-section planned more than 60minutes before delivery (semi-elective section and elective section) Emergency caesarean section: C-section performed <60 minutes before delivery (crash section, urgent section and emergency section) Further classification of urgency of emergency caesarean section, based on the hospital (study site) classification Crash Section: C-section performed <20 minutes after the decision made Urgent Section: C-section performed <30 minutes after the decision made Emergency Section: C-section performed <60 minutes after the decision made Semi-Elective Section: C-section performed <24 hours after the decision made Elective Section: C-section planned more than 24 hours before delivery	Categorical 1' SVD' 2 'Breech' 'instrumental' 3 'Elective CS' 4 'Emergency CS' Categorical 1' SVD' 2 'Breech' 3 'Forceps' 4 'Ventouse' 5 'Elective CS' 6 'Semi-elective CS' 7 'Crash CS' 8 'Urgent CS' 9 'Emergency CS'	Clinical record (maternity records)
3rd/4th degree perineal tear	Third degree: Injury to perineum involving the anal sphincter complex Fourth degree: Injury to perineum involving the anal sphincter complex and anal epithelium Royal College of Obstetricians and Gynaecologists (RCOG) (2007). The management of third- and fourth-degree perineal tears. Green-top guideline No. 29, March 2007. http://www.rcog.org.uk/womens-health/clinical-guidance/management-third-and-fourth-degree-perineal-tears-green-top-29	Binary 1 'no' 2 'Third degree tear' (note: no cases of 4th degree tear)	Clinical record (maternity records)
Manual removal of placenta (MRP)	Placenta is removed manually from the uterus after a vaginal birth	Binary 1 'no' 2 'MRP'	Clinical record (maternity records)

Variables	Definition/criteria/classification	Type of variable	Data source
Obstetric haemorrhage	Major obstetric haemorrhage: Estimated blood loss ≥1500ml (either vaginal or CS related), or transfused 4 or more units of blood Mild obstetric haemorrhage: Estimated blood loss ≥500ml, <1500ml (either vaginal or CS related), or transfused 1-3 units of blood Waterstone et al. 2001, WHO 2003	Binary 1 'major obstetric haemorrhage' 2 'no' Ordinary 1 'major obstetric haemorrhage' 2 'mild obstetric haemorrhage 3 'no'	Clinical record (maternity records, blood transfusion records)
Hypertensive disorder Pre-eclampsia Eclampsia	Eclampsia: a convulsive condition associated with pre-eclampsia (Altman et al. 2002, RCOG, 2006) Severe pre-eclamspia: pre-eclampsia with an existence of blood pressure of 160/110 mmHg (NICE 2010) Pre-eclampsia: New hypertension (a diastolic blood pressure of 90 mmHg or a systolic blood pressure >140mmHg) and new onset proteinuria (as shown by 1 + or more, on dipstick testing, a protein/creatinine ratio of 30mg/mmol or more on random sample or a urine protein excretion of 0.3g or more per 24 hours) at or after 20 weeks of pregnancy (Guy's and St Thomas' NHS Foundation, 2009) Hypertension: Hypertension at or after 20 weeks gestation in a women with a diastolic blood pressure of 90mmHg or a systolic blood pressure>140mmHg or more (Guy's and St Thomas' NHS Foundation, 2009)	Binary 1 'severe PET or eclampsia' 2 'no' Ordinary 1 'severe PET or eclampsia' 2 'PET or hypertension 3 'no'	Clinical record (maternity records, HDU records)
HDU admission	HDU admission after giving birth	Binary 1 'HDU admission' 2 'no'	Clinical record (maternity records, HDU records)
Gestational age at delivery	Preterm: infant born before the thirty-seventh completed week of gestation; ≤36 (6/7) weeks gestation Term: infant born in the interval from the thirty-seventh completed week to the forty-second completed week of gestation; 37 (0/7) to 41 (6/7) weeks gestation Postterm: infant born at 42 weeks of gestation or beyond; ≥42 (0/7)	Continuous (weeks) Categorical 1 '<37 weeks of gestation' 2 '>=37, <42 weeks of gestation' 3 '>=42 weeks of gestation'	Clinical record (maternity records)
Birth weight	Infant's weight recorded at the time of birth. Birth weight < 2500g is considered to be low birth weight.	Continuous (g) Ordinal 1 '<1500' 2 '>=1500, <2500' 3 '>=2500, <3500' 4 '>=3500, <4500' 5 '>=4500'	Clinical record (baby's records)

Variables	Definition/criteria/classification	Type of variable	Data source
Apgar score	A means of evaluating the physical condition of infants shortly after delivery (one and five minutes after delivery) from the total score of the five conditions: • activity and muscle tone • pulse (heart rate) • grimace response (medically known as "reflex irritability") • appearance (skin coloration) • respiration (breathing rate and effort) Each condition is scored on a scale of 0 to 2 and a total score can range from 0 to 10. Higher score shows better condition. Casey BM, McIntire DD, Leveno KJ (2001). "The continuing value of the Apgar score for the assessment of newborn infants". *N Engl J Med.* 344 (7): 467–471. Apgar V, James LS. Further observations on the newborn scoring system. Am J Dis Child 1962;104:419-28.	Continuous Categorical 1 '0-3' 2 '4-6' 3 '7-10'	Clinical record (baby's records)
NICU admission	Baby transferred to the NICU after he or she was born	Binary 1 'NICU admission' 2 'no'	

Appendix 7. SF-12

UK SF-12



THE U.K. SHORT FORM 12 HEALTH SURVEY QUESTIONNAIRE (UK SF-12)

The following questions ask for your views about your health, how you feel and how well you are able to do your usual activities.

If you are unsure about how to answer any questions please give the best answer you can and make any of your own comments if you like. Do not spend too much time in answering as your immediate response is likely to be the most accurate.

1. In **general**, would you say your health is *(please tick one box)*

Excellent | Very good | Good | Fair | Poor

2. HEALTH AND DAILY ACTIVITIES

The following questions are about activities you might do during a typical day. Does your health limit you in these activities? If so, how much? *(please tick one box on each line)*

		Yes, limited a lot	Yes, limited a little	No, not limited at all
a)	**Moderate activities**, such as moving a table, pushing a vacuum, bowling or playing golf			
b)	Climbing **several** flights of stairs			

3. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health?** *(Please answer Yes or No to each question)*

		Yes	No
a)	**Accomplished less** than you would like		
b)	Were limited in the **kind** of work or other activities		

4. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)? *(Please answer Yes or No to each question)*

		Yes	No
a)	**Accomplished less** than you would like		
b)	Didn't do work or other activities as **carefully** as usual		

5. During the **past 4 weeks** how much did **pain** interfere with your normal work (including work both outside the home and housework)? *(Please tick one box)*

Not at all | A little bit | Moderately | Quite a bit | Extremely

YOUR FEELINGS

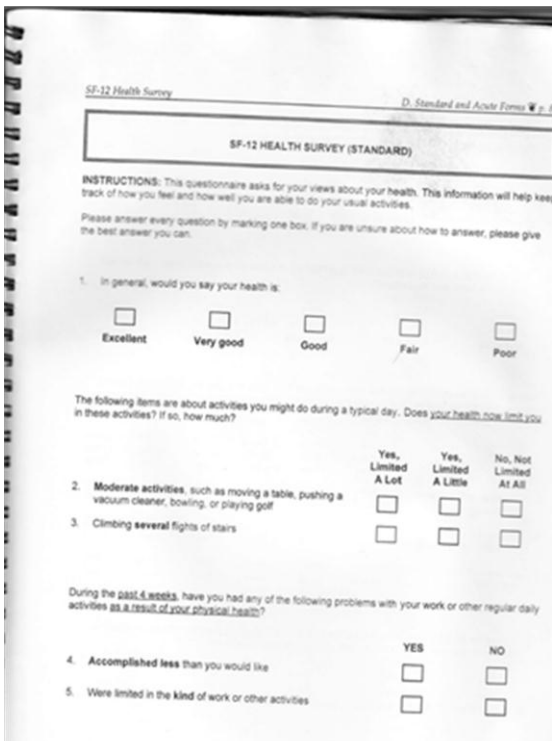
6. These questions are about how you feel and how things have been with you **during the past month**. For each question, please indicate the one answer that comes closest to the way you have been feeling. *(Please tick one box on each line)*

How much time during **the last month:**	**All of the time**	**Most of the time**	**A good bit of the time**	**Some of the time**	**A little of the time**	**None of the time**
a) Have you felt calm and peaceful?						
b) Did you have a lot of energy?						
c) Have you felt downhearted and low?						
d) Has your **health limited your social activities** (like visiting friends or close relatives)?						

SF-12 *is a trade mark of the Medical Outcomes Trust*

Source: Jenkinson et al. (1997a, p181)

US SF-12



SF-12 Health Survey

SF-12 HEALTH SURVEY (STANDARD)

INSTRUCTIONS: This questionnaire asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Please answer every question by marking one box. If you are unsure about how to answer, please give the best answer you can.

1. In general, would you say your health is:

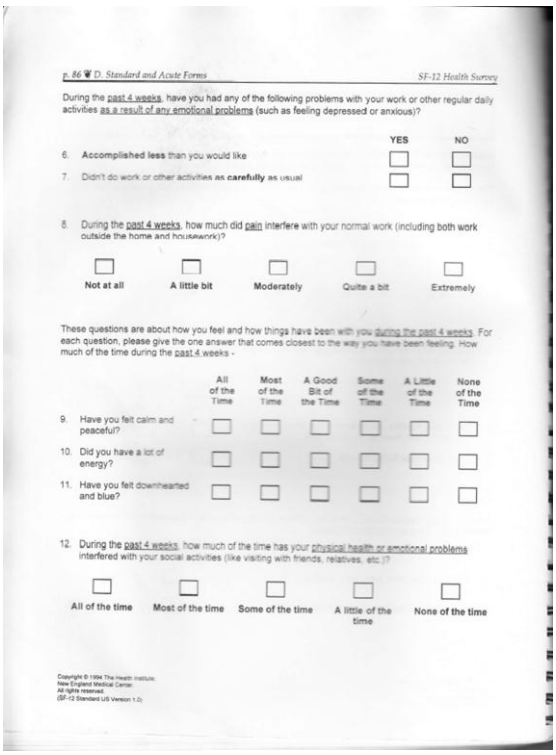
Excellent | Very good | Good | Fair | Poor

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
2. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf			
3. Climbing **several** flights of stairs			

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	YES	NO
4. **Accomplished less** than you would like		
5. Were limited in the **kind** of work or other activities		



p. 86 ❦ D. Standard and Acute Forms — SF-12 Health Survey

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	YES	NO
6. Accomplished less than you would like		
7. Didn't do work or other activities as carefully as usual		

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all | A little bit | Moderately | Quite a bit | Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks -

	All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
9. Have you felt calm and peaceful?						
10. Did you have a lot of energy?						
11. Have you felt downhearted and blue?						

12. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

All of the time | Most of the time | Some of the time | A little of the time | None of the time

Source: Ware et al. (1995, p.85-86)

Appendix 8. Invitation letter with opt-out sheet

Study site logo

NHS Foundation Trust

Study site address

(Date)

Women's Health after having a baby

I am writing to invite you to participate in a research study which is taking part in this hospital. The aim of the study is to find out more about women's emotional and physical health in the first six weeks after having a baby. The study also aims to find out if women's health after having a baby is related to women's birth experience and health care that women received during childbirth and postnatal period. Your participation will help us to consider how we can improve our health services for women who have had a baby in the hospital as well as when women have been discharged home. The study is being carried out by a researcher from King's College London as a part of PhD study. The study has received the approval of research ethics committees at St. Thomas' Hospital. For more details, please see the information sheet provided to you.

The research team would like to invite you to answer one questionnaire at 6 weeks after having your baby. In the questionnaire, you will be asked about your experience of giving birth, your views of the health care you received during labour and birth at our hospital and at home. You will also be asked about how you feel physically and mentally at the time of answering the questionnaire. Completing the questionnaire will take about 30 minutes.

All the information you provide will remain anonymous. Your personal information will be treated as confidential and your name will not be used in any of the study findings. We would be very grateful if you would give your permission to send you the study questionnaire and to collect information about your birth from your maternity records held at the hospital. This information will enable us to see, for example, if women who have a particular type of birth or are having their first baby, are more likely to experience particular health problems.

If you would prefer *not* to take part in this research project, please either e-mail to the researcher, Marie Furuta (marie.furuta@kcl.ac.uk) or leave a message on her phone (078 6397 8520) within 3 weeks of receiving this letter. You can also return the tear-off slip below using the FREEPOST envelope enclosed. Please write your name clearly so we can ensure that we do not contact you. Your maternity care will not be affected in any way.

If you are happy to take part, you don't need to contact us – we will be in touch when we would like you to complete the questionnaire. Once you receive the questionnaire through the post, completing is still entirely up to you. Your contact details will not be passed on to anyone outside the research team or used for any purpose apart from this study.

Many thanks for reading this letter. We do hope you are happy to take part in this important study.

Yours sincerely,
(Sign)

Lynne Pacanowski
Head of Midwives
Guy's and St Thomas' NHS Foundation Trust

Opt-out sheet

If you prefer not to participate in this research, please fill in your name in capitals and return this sheet using Freepost envelope.

☐ Please do not send me a questionnaire

Your name: _____ Date: date / month / 2010

Appendix 9. Patient's information sheet

Study site logo

NHS Foundation Trust

KING'S College LONDON

Women's health after having a baby

INFORMATION SHEET

WOMEN'S HEALTH AFTER HAVING A BABY

We would like to invite you to take part in a study to explore women's health after they have given birth. A researcher from King's College London is carrying out the survey as part of a PhD study.

What is the purpose of the study?

The main purpose is to explore women's health in the six weeks after they have given birth. The study will help us to find out if the care that women receive during childbirth and the postnatal period could be improved and if so, how we could improve it. To do this, we would like to find out about your postnatal health by asking you to complete a postal questionnaire. The questionnaire will ask you about information on:

- Your emotional and physical health after giving birth
- Your birth experience
- Your satisfaction and dissatisfaction with your maternity care

Below are some other questions people often ask about such research and our answers.

Who is organising the research?

The study is being run by King's College London in collaboration with St. Thomas' Hospital, London.

Who has approved the study?

The study has been approved by an NHS Research Ethics Committee (Camden and Islington Community Research Ethics Committee, study reference 10/H0722/15).

Why have I been invited to take part?

We are inviting all women aged over 16 who give birth under the care of staff in St Thomas' Hospital over 6 months in 2010 to take part. Your participation is entirely voluntary, but we do hope you can help us by taking part.

What would be involved in taking part?

You will be asked to complete a questionnaire 6 -8 weeks after your baby's birth. You will receive the questionnaire by post. The questionnaire will take about 15 minutes to complete. The questionnaire is very simple and most of the questions can be answered with a 'tick'. You will be asked to return the completed questionnaire directly to us at the study co-ordinating unit, using the FREEPOST envelope which will be enclosed with the questionnaire.

How is the study organised?

The information you provide us through the questionnaires will be stored on a secure computer at the University. The results will be analysed together with any relevant information from your maternity record (for example, what sort of birth you had). We would therefore also like to ask for your permission to access your medical records from the hospital in which you gave birth.

Is confidentiality guaranteed?

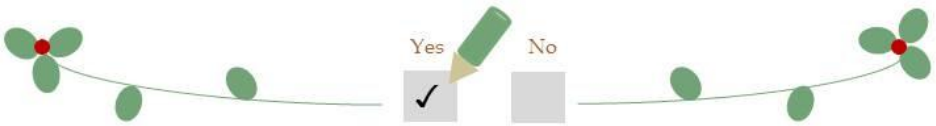
We guarantee that all information provided to the study will be treated with absolute confidentiality. All information will be kept in accordance with the Data Protection Act, 1998.

All the information you give will remain anonymous and it will not be possible to identify you from the published results. All documents which contain your personal information (your name, postcode, address, etc.) will be securely stored in King's College London and then destroyed at the end of the study.

However, if, during the course of the study, you indicate that you are particularly unwell or if there are concerns about your baby's health and welfare, you may benefit from talking to someone who can offer you further support. In this event we will ask if you would like us to refer you to the most appropriate health professional who will be able to advise you further (eg GP or health visitors).

Will taking part be of any benefit to me?

Perhaps not immediately and directly, but we hope you will find it helpful and interesting to share your postnatal experiences with us.
We also hope that the study findings will help to improve health services during childbirth and the postnatal period.



Are there any disadvantages to taking part?

We recognise that helping us with this study will take up some of your time. We will do our best to minimise any inconvenience for you by providing enough time for you to complete the questionnaire, and assistance to complete it if required.

Although we do not expect anyone to suffer any harm as a result of participating in the study, we do have insurance cover. Answering the questionnaire may cause unexpected distress because we will ask you, in the postal questionnaire, to recall your birth experience and health care services you received during and after birth. You may find these questions insensitive, particularly if you had experienced an extremely distressing birth such as losing your baby. We have listed the emotional support available to you on the next page (p.4). Study participation is entirely voluntary. You have the right not to participate by opting out or not answering or returning the questionnaire. The treatment and advice you receive will be the same whether you take part or not.

What if I have concerns?

If you have any questions about the study or you start to feel anxious, please feel free to contact the research team using the contact details on the back of this leaflet. We will be very happy to discuss your concerns and/or put you in touch with someone who will be able to help. If you have depressed feelings or any other psychological conditions, please contact your GP or other specialists. Psychological support services are also available in your local area which are listed on the next page (p.4).

What if I change my mind?

You can withdraw from the study at any time without having to give an explanation, and without your healthcare being affected in any way.

How and where will the results be published?

We plan to publish the findings, in consumer, academic and professional journals, on the internet and at conferences geared towards associations involved in improving postnatal services. We will also send you a summary of the research findings at the end of the study.

Organisations that can help

Association for Post Natal illness
www.apni.org
145 Dawes Rd, Fulham, London SW6 7EB
Tel: 020 7386 0868 (10am - 2pm Mon - Fri)
Provides support to mothers suffering from post-natal illness.

Meet-A-Mum-Association (MAMA)
www.mama.co.uk
7 Southcourt Rd, Leighton Buzzard, Beds, LU7 2QF
Tel: 0845 120 3746 (7pm - 10pm Mon - Fri)
Provides support for mothers who feel depressed and isolated when their babies are born.

National Childbirth Trust
www.nctpregnancyandbabycare.com
Alexandra House, Oldham Terrace, London W3 6NH
Tel: 0300 330 0773 (postnatal line 9am - 1pm Mon - Fri)
Provides advice, support and counseling on all aspects of childbirth and early parenthood.

Stillbirth and Neonatal Death Society
www.uk-sands.org
28 Portland Place, London W1N 4DE.
Tel: 020 7436 5881 (9.30am - 5.30pm Mon - Fri, 6pm-10pm The & Thu)
Provides support for anyone affected by the death of a baby

Emergency mental and emotional services

If you need an emergency psychiatric service, it is possible to visit your local Accident and Emergency (A&E) department and ask to see the duty psychiatrist. St. Thomas' Hospital has A&E Mental Health Liaison (020 7188 2151). You can also find the A&E, emotional support and psychological therapy services available in your area on the website of NHS Choices: www.nhs.uk/Pages/HomePage.aspx

If you feel desperate or need to speak to someone urgently during the day and night you can call:

- **NHS Direct** (0845 46 47) for mental health advice and information (24 hour helpline)
- **Samaritans** (08457 909090) for emotional support (24 hour helpline)

THANK YOU VERY MUCH FOR READING THIS LEAFLET

To show our appreciation of your time, everyone who returns a questionnaire will be entered into a raffle which will take place monthly during the study period.

Each month, the first prize will be a *£50* Marks & Spencer voucher and the second prize a *£30* voucher. The winners will be selected through a computer random selection system. The vouchers will be sent to the winners by post at the beginning of each month.

Researchers

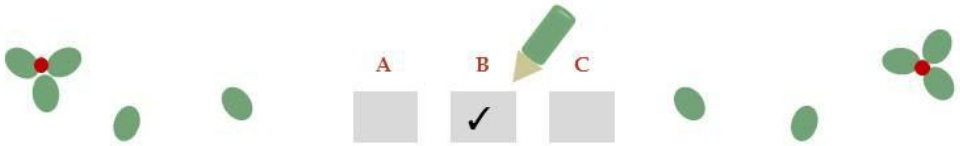
Marie Furuta, MSc (PhD student)
Florence Nightingale School of Nursing & Midwifery
King's College London
Tel. 0207 848 3625 E-mail. marie.furuta@kcl.ac.uk

Professor Debra Bick, PhD, Professor of Evidence Based Midwifery Practice
Florence Nightingale School of Nursing & Midwifery
King's College London
Tel. 0207 848 3641 E-mail. debra.bick@kcl.ac.uk

Professor Jane Sandall, PhD, Professor of Women's Health
Department of Public Health
King's College London
Tel. 0207 848 6261 E-mail. jane.sandall@kcl.ac.uk

The normal NHS complaints mechanism is available to you if you wish to complain about any aspect of the way you are approached or treated during the course of this study. Formal complaints may be addressed to Professor Anne Marie Rafferty, Head of Florence Nightingale School of Nursing and Midwifery, King's College London, tel. 020 7848 3563

Should you require independent advice, you may wish to contact the Patient Advice and Liaison Service in Guy's and St Thomas' Hospital, ph. 0207 188 8801. You can also contact the National Childbirth Trust through their website www.nctpregnancyandbabycare.com, or you may wish to look up the INVOLVE website www.invo.org.uk



Appendix 10. Cover latter for questionnaire

Study site logo

NHS Foundation Trust

KING'S College LONDON

Women's health after having a baby

Dear

I am a midwife and a PhD student from King's College London, and I am doing some research into women's health after having a baby. You may remember receiving a letter asking for your help with this study from Mrs Lynne Pacanowski (the Director of Midwifery at St Thomas') during your stay in hospital, but in case you were discharged without receiving one, I have included an information sheet in this pack. The study has been approved by an NHS research ethics committee (Camden & Islington Community, REC 10/H0772/15 March 2010.)

Also enclosed is a questionnaire for the study. Your participation is entirely voluntary, but I do hope you can help by taking part. The questionnaire asks about your birth experience. It also includes some questions about your emotional and physical well-being since giving birth.

All the information you give will remain anonymous and confidential. The identification number on the first page is used simply to check whether I have received your completed questionnaire.

I would be very grateful if you could take the time to complete this questionnaire. The completed questionnaire (and the consent form on the back of this letter) should be returned to me using the enclosed FREEPOST envelopes. Please sign both consent forms. The second consent form is for you to keep for your records. I would really value hearing your views, and I will write once to remind you if I have not heard from you in two weeks, as I understand that you will be busy at the moment.

If the survey raises issues or questions of concern about your own health, then you may wish to contact your midwife, GP or health visitor. If you would like to complete this questionnaire over the telephone, or if you would like any more information about the project, please contact Marie Furuta, on 0207 848 3625 or e-mail marie.furuta@kcl.ac.uk.

To show our appreciation of the time you contribute to this study, everyone who returns a completed questionnaire will be entered into a raffle. Each month, the first prize will be a £50 Marks & Spencer voucher and the second prize a £30 voucher. I will notify winners at the beginning of each month.

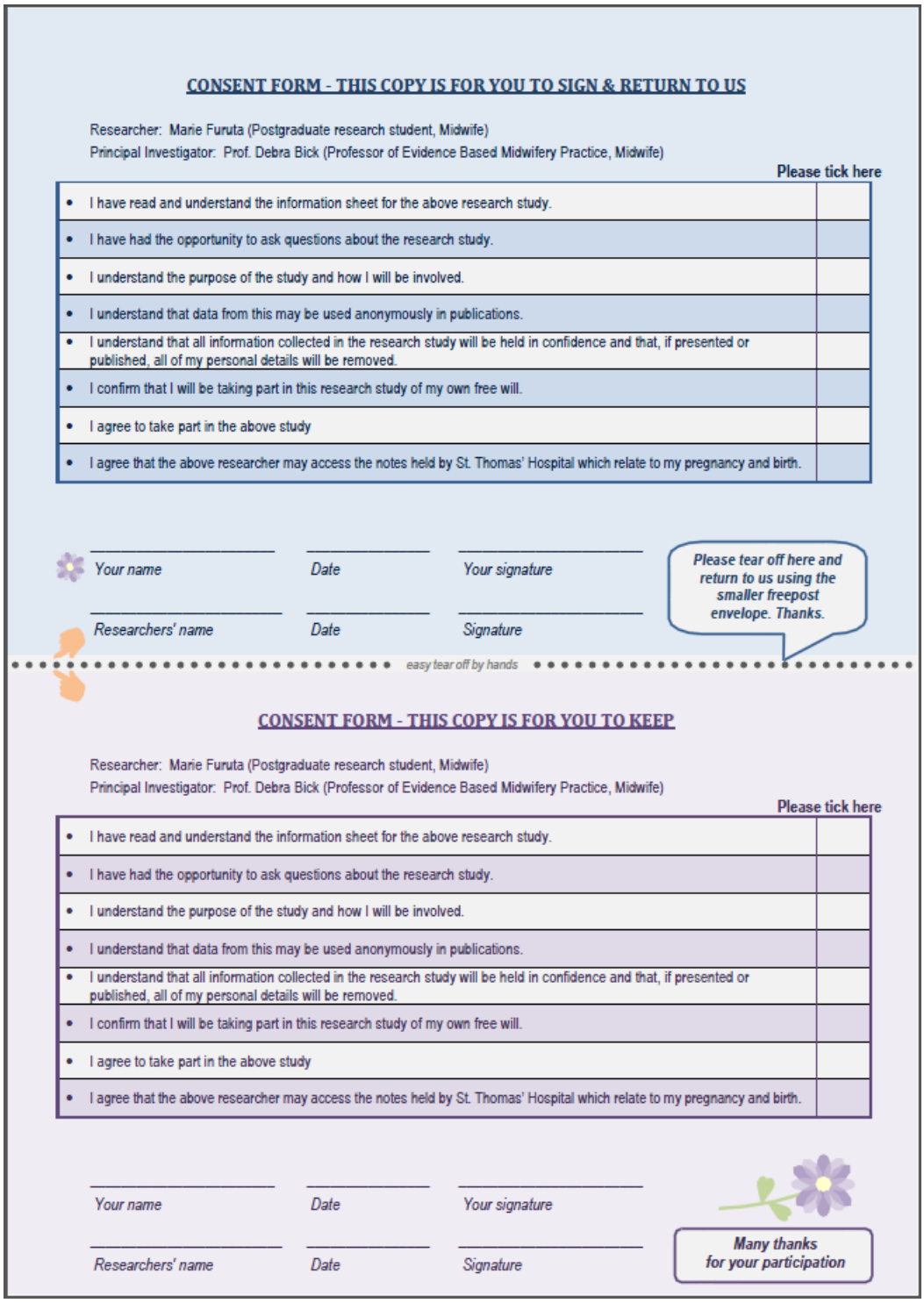
Yours sincerely,

Marie Furuta

Marie Furuta, Professor Debra Bick & Professor Jane Sandall

Florence Nightingale School of Nursing & Midwifery
King's College London
James Clerk Maxwell Building, 57 Waterloo Road, London, SE1 8WA
Tel: 0207 848 3625 Mobile: 078 6397 8520
E-mail: marie.furuta@kcl.ac.uk

Appendix 11. Consent form



CONSENT FORM - THIS COPY IS FOR YOU TO SIGN & RETURN TO US

Researcher: Marie Furuta (Postgraduate research student, Midwife)
Principal Investigator: Prof. Debra Bick (Professor of Evidence Based Midwifery Practice, Midwife)

	Please tick here
• I have read and understand the information sheet for the above research study.	
• I have had the opportunity to ask questions about the research study.	
• I understand the purpose of the study and how I will be involved.	
• I understand that data from this may be used anonymously in publications.	
• I understand that all information collected in the research study will be held in confidence and that, if presented or published, all of my personal details will be removed.	
• I confirm that I will be taking part in this research study of my own free will.	
• I agree to take part in the above study	
• I agree that the above researcher may access the notes held by St. Thomas' Hospital which relate to my pregnancy and birth.	

Your name *Date* *Your signature*

Researchers' name *Date* *Signature*

Please tear off here and return to us using the smaller freepost envelope. Thanks.

easy tear off by hands

CONSENT FORM - THIS COPY IS FOR YOU TO KEEP

Researcher: Marie Furuta (Postgraduate research student, Midwife)
Principal Investigator: Prof. Debra Bick (Professor of Evidence Based Midwifery Practice, Midwife)

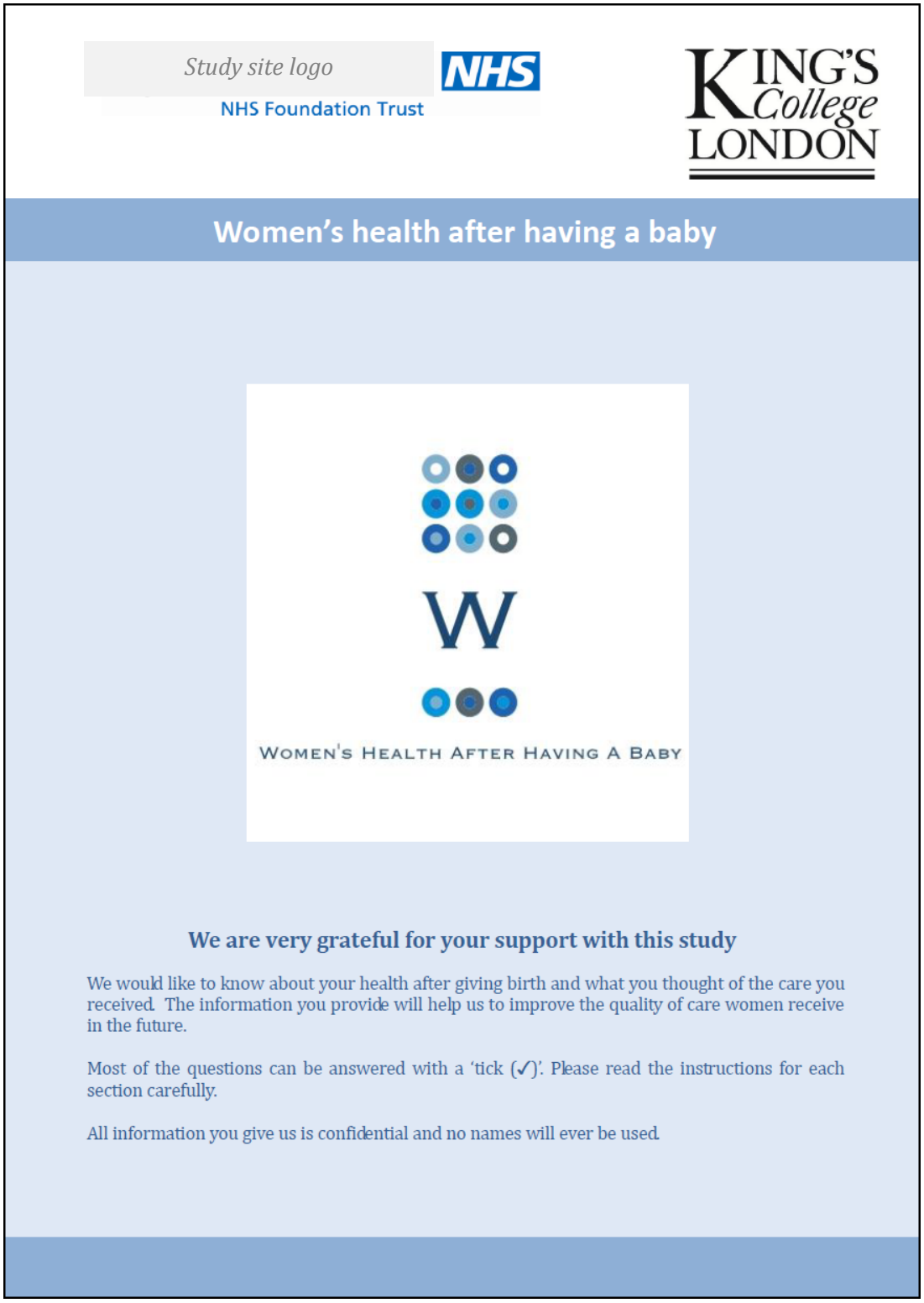
	Please tick here
• I have read and understand the information sheet for the above research study.	
• I have had the opportunity to ask questions about the research study.	
• I understand the purpose of the study and how I will be involved.	
• I understand that data from this may be used anonymously in publications.	
• I understand that all information collected in the research study will be held in confidence and that, if presented or published, all of my personal details will be removed.	
• I confirm that I will be taking part in this research study of my own free will.	
• I agree to take part in the above study	
• I agree that the above researcher may access the notes held by St. Thomas' Hospital which relate to my pregnancy and birth.	

Your name *Date* *Your signature*

Researchers' name *Date* *Signature*

Many thanks for your participation

Appendix 12. Questionnaire



Section 1 This section is about your general health

1. **In general, would you say your current health is**

Excellent	Very good	Good	Fair	Poor
☐	☐	☐	☐	☐

2. **The following questions are about activities you might do during a typical day. Does your current health limit you in these activities? If so, how much?** (please tick **one** box on each line)

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a) Moderate activities, such as moving a table, pushing a vacuum			
b) Climbing several flights of stairs			

3. **During the past 4 weeks, have you had any of the following problems with your regular daily activities as a result of your physical health?** (please answer Yes or No to each line)

	Yes	No
a) Accomplished less than you would like		
b) Were limited in the kind of daily activities		

4. **During the past 4 weeks, have you had any of the following problems with your regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?**

	Yes	No
c) Accomplished less than you would like		
d) Didn't do daily activities as carefully as usual		

5. **During the past 4 weeks how much did pain interfere with your normal work (including work both outside the home and housework)?** (please tick **one** box)

Not at all	A little bit	Moderately	Quite a bit	Extremely
☐	☐	☐	☐	☐

6. **These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please indicate the one answer that comes closest to the way you have been feeling.** (please tick one box on each line)

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a) Have you felt calm and peaceful?						
b) Did you have a lot of energy?						
c) Have you felt downhearted and low?						
d) Has your health limited your social activities (like visiting friends or close relatives)?						

SF-12 (Ware et al 1997)

Section 2 This section is about your feelings when you gave birth to your baby

7. Just as no two women are exactly alike, no two women have exactly the same experiences during childbirth. Please try to recall your labour and your baby's birth as vividly as you can. Think about your feelings during labour and birth. Of course, you probably had many different feelings, but try to remember what it was generally like for you during this time. Please try to rate each statement on its own. Do not consider the other statements. Tick the box on each line which relates most closely to your experiences of childbirth.

	Almost all of the time	A lot but not always	A little more than half the time	About half the time	Slightly less than half the time	Sometimes	Never or Almost never
1. I felt tense							
2. I felt important							
3. I felt confident							
4. I felt in control							
5. I felt fearful							
6. I felt relaxed							
7. I felt good about my behaviour							
8. I felt helpless (powerless)							
9. I felt I was with people who care about me							
10. I felt like a failure							

Labour Agentry Scale (Hodnett et al 1986)

Section 3 This section is about your care after you left hospital

8. How many visits from midwives and health visitors did you have for postnatal care at your home?

(Please circle the total number of visits)

Midwives	0	1	2	3	4	5	6 or more
Health Visitors	0	1	2	3	4	5	6 or more

9. Did you visit your GP for a 6 week postnatal check?

☐ No ☐ Yes

10. Apart from the 6 week postnatal check, did you seek care from any health professionals at a place *other* than your home, following the birth of your baby?

☐ No (If No, please go to Question 11)

☐ Yes → ☐ for yourself
☐ for your baby

If YES, please answer below

	Where?	*Reason for visit(s)?*
☐	GP practice	Please state .....
☐	Children's Centre	Please state .....
☐	Community clinics	Please state .....
☐	Hospital postnatal clinic	Please state .....
☐	Other (where?.....)	Please state .....

11. Did you have to be re-admitted to hospital at any time?

☐ No

☐ Yes → Please state how long after the birth you were re-admitted to hospital
( ) days after birth
What was the reason for re-admission? .....

12. Did your baby have to be re-admitted to hospital at any time?

☐ No

☐ Yes → Please state how long after the birth your baby was re-admitted to hospital
( ) days after birth
What was the reason for re-admission? .....

13. Have you breastfed your baby at any time since he or she was born?

☐ No

☐ Yes → Are you still breastfeeding your baby?
☐ No
☐ Yes, breast plus formula milk
☐ Yes, only breast milk

Many thanks
You are half way through!

Section 4 This section is about your feelings "right now"

14. The following statements are about the help and support you have to look after yourself and your baby.

(Please tick one box on each line to show how often you feel like this)

	This is exactly how I feel	This is often how I feel	This is how I sometimes feel	I never feel this way
1. I have no one to share my feelings with				
2. My partner provides the emotional support I need				
3. There are other mothers with whom I can share my experiences				
4. I believe in moments of difficulty my neighbours would help me				
5. I 'm worried that my partner might leave me				
6. There is always someone with whom I can share my happiness and excitement about my baby				
7. If I feel tired I can rely on my partner to take over				
8. If I was in financial difficulty I know my family would help if they could				
9. If I was in financial difficulty I know my friends would help if they could				
10. If all else fails I know health and social services will support and assist me				

15. Aside from your birth, have you experienced any changes in your life within the last 6 weeks, which has caused you anxiety or depression (e.g. loss of loved one, redundancy) ?

☐ No

☐ Yes (could you please say what? .....)

Section 5 This section is about how you have felt in the "past week" (the last 7 days)

16. In the following questions, please tick the answer which comes closest to how you have felt in the past week, not just today.

- **In the past week, I have been able to laugh and see the funny side of things:**

As much as I always could	Not quite so much now	Definitely not so much now	Not at all
☐	☐	☐	☐

- **In the past week, I have looked forward with enjoyment to things:**

As much as I ever did	Rather less than I used to	Definitely less than I used to	Hardly at all
☐	☐	☐	☐

- **In the past week, I have blamed myself unnecessarily when things went wrong:**

Yes, most of the time	Yes, some of the time	Not very often	No, never
☐	☐	☐	☐

- **In the past week, I have been anxious or worried for no good reason:**

No, not at all	Hardly ever	Yes, sometimes	Yes, very often
☐	☐	☐	☐

- **In the past week, I have felt scared or panicky for no very good reason:**

Yes, quite a lot	Yes, sometimes	No, not much	No, not at all
☐	☐	☐	☐

- **In the past week, things have been getting on top of me:**

Yes, most of the time I haven't been able to cope at all	Yes, sometimes I haven't been coping as well as usual	No, most of the time I have coped quite well	No, I have been coping as well as ever
☐	☐	☐	☐

- **In the past week, I have been so unhappy that I have had difficulty sleeping:**

Yes, most of the time	Yes, sometimes	Not very often	No, not at all
☐	☐	☐	☐

- **In the past week, I have felt sad or miserable:**

Yes, most of the time	Yes, quite often	Not very often	No, not at all
☐	☐	☐	☐

- **In the past week, I have been so unhappy that I have been crying:**

Yes, most of the time	Yes, quite often	Only occasionally	No, never
☐	☐	☐	☐

- **In the past week, the thought of harming myself has occurred to me:**

Yes, quite often	Sometimes	Hardly ever	Never
☐	☐	☐	☐

Edinburgh Postnatal Depression Scale (Cox et al 1987)

17. Below is a list of statements which we would like you consider with respect to giving birth to your baby. Please read each of the statements listed below, indicating which, if any, were true for you during *the past seven days*. (If a statement does not apply to you, please mark the "not at all" column)

***By "it"**, we mean "an event or experience during your labour, or the birth of your baby, or immediately after the birth (within 24 hours) that **made you feel anxious and frightened**".*

	Not at all	Rarely	Sometimes	Often
1. I thought about *it* when I didn't mean to.				
2. I avoided letting myself get upset when I thought about *it* or was reminded of *it*.				
3. I tried to remove *it* from memory.				
4. I had trouble falling asleep or staying asleep, because of pictures or thoughts about *it* that came into my mind.				
5. I had waves of strong feelings about *it*.				
6. I had dreams about *it*.				
7. I stayed away from reminders of *it*.				
8. I felt as if *it* hadn't happened or *it* wasn't real.				
9. I tried not to talk about *it*.				
10. Pictures (thoughts) about *it* popped into my mind.				
11. Other things kept making me think about *it*.				
12. I was aware that I still had a lot of feelings about *it*, but I didn't deal with them.				
13. I tried not to think about *it*.				
14. Any reminder brought back feelings about *it*.				
15. My feelings about *it* were kind of numb.				

Impact Event Scale (Horowitz et.al 1979)

Section 6 This section asks you about yourself

18. Could you please tell us if you live with any other adults?

None ☐ Husband/partner ☐ Parents/sisters/brothers ☐ Other (please specify:) ☐

19. Could you please tell us the highest level of education qualification you have gained?

None ☐ GCSE level (CSE or O Level or equivalent) ☐ A Level or equivalent ☐ Degree or equivalent (or above) ☐

You've finished!

Do you have any comments you would like to make about your care after giving a birth?
(e.g. the things you were most satisfied or dissatisfied about with your postnatal care)

Satisfied

Dissatisfied

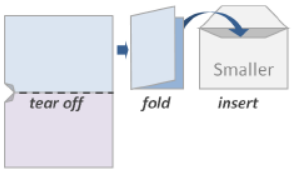
Thank you very much for completing this questionnaire

Please fill in the date you completed the questionnaire Date / Month / Year

☐ Please tick a box if you wish to receive a copy of the results when study is completed in 2012

① Please sign the two consent forms we have sent you (on the back of the letter): one for you to keep & one for us.

② Please return one of the signed consent forms to us using the smaller freepost envelope included.



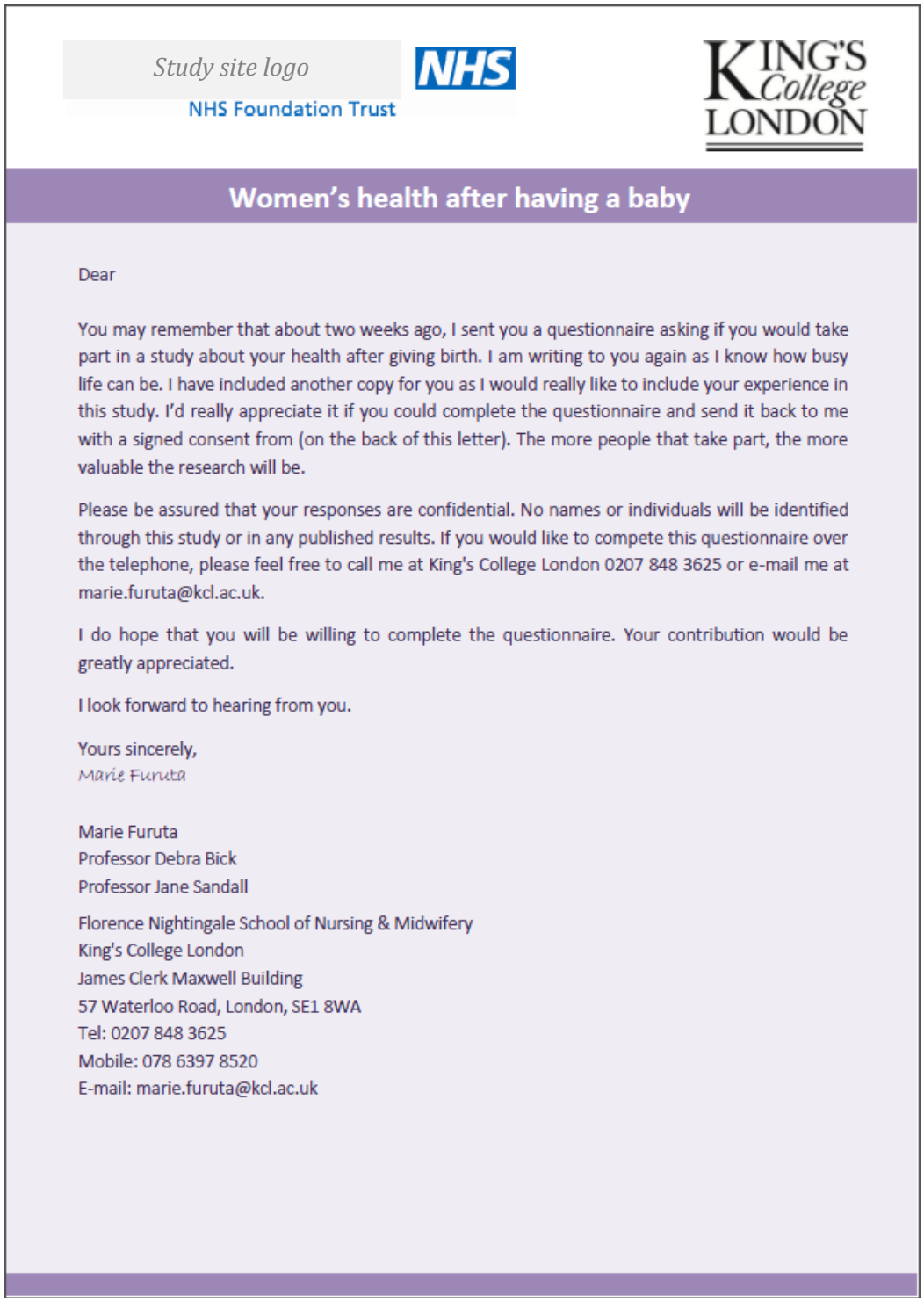
③ Please return the questionnaire to us using the larger freepost envelope included.

Raffle Schedule

Questionnaire returned by:	Raffles taken place on:	Vouchers sent to winners on:
25 Aug 2010	30 Aug 2010	1 Sep 2010
25 Sep 2010	30 Sep 2010	1 Oct 2010
25 Oct 2010	28 Oct 2010	1 Nov 2010
25 Nov 2010	30 Nov 2010	1 Dec 2010
25 Dec 2010	30 Dec 2010	3 Jan 2011
25 Jan 2011	28 Jan 2011	1 Feb 2011
28 Feb 2011	1 Mar 2011	1 Mar 2011

Thank you! Everyone who returns a questionnaire will be entered into a raffle.
Each month, the 1st prize will be a Marks & Spencer £50 voucher and the 2nd prize a £30 voucher.
Prize winners will be selected using a computer programme. The vouchers will be sent to the winners by post.

Appendix 13. Reminder letter



Study site logo

NHS Foundation Trust

KING'S College LONDON

Women's health after having a baby

Dear

You may remember that about two weeks ago, I sent you a questionnaire asking if you would take part in a study about your health after giving birth. I am writing to you again as I know how busy life can be. I have included another copy for you as I would really like to include your experience in this study. I'd really appreciate it if you could complete the questionnaire and send it back to me with a signed consent from (on the back of this letter). The more people that take part, the more valuable the research will be.

Please be assured that your responses are confidential. No names or individuals will be identified through this study or in any published results. If you would like to compete this questionnaire over the telephone, please feel free to call me at King's College London 0207 848 3625 or e-mail me at marie.furuta@kcl.ac.uk.

I do hope that you will be willing to complete the questionnaire. Your contribution would be greatly appreciated.

I look forward to hearing from you.

Yours sincerely,
Marie Furuta

Marie Furuta
Professor Debra Bick
Professor Jane Sandall

Florence Nightingale School of Nursing & Midwifery
King's College London
James Clerk Maxwell Building
57 Waterloo Road, London, SE1 8WA
Tel: 0207 848 3625
Mobile: 078 6397 8520
E-mail: marie.furuta@kcl.ac.uk

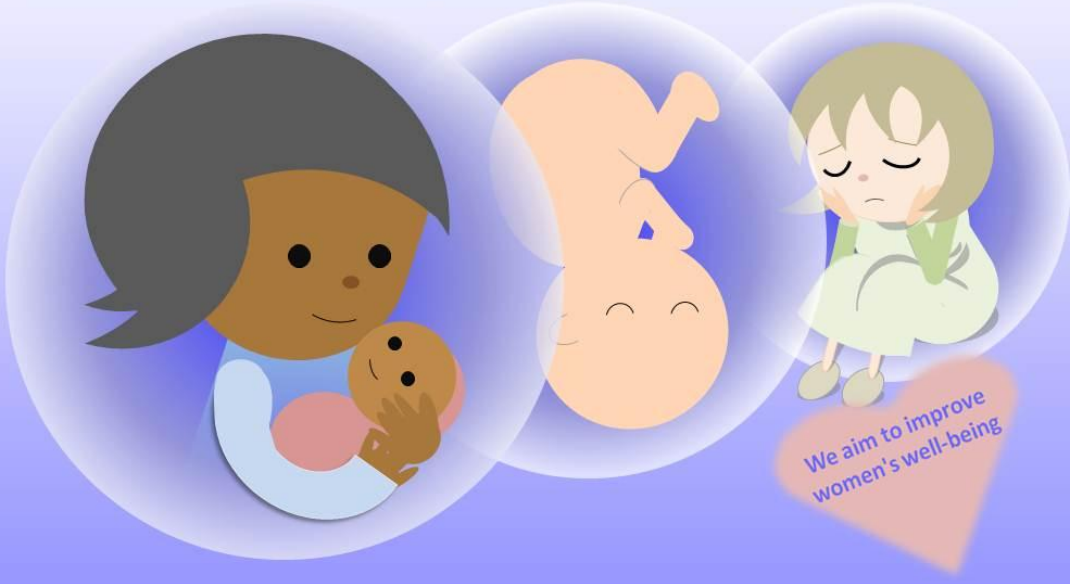
Appendix 14. Poster for women

Study site logo

NHS Foundation Trust

KING'S College LONDON

WOMEN'S HEALTH AFTER HAVING A BABAY



A study is currently being conducted at this hospital which is looking at women's emotional and physical health after giving a birth. The information you provide will help us to find out if the care women receive during birth and in the first 6-8 weeks of birth could be improved and if so, how we could improve it.

We are inviting all women (NHS patients) aged 16 years and over, who have given birth in this hospital or at home and who can read and understand English. Women who can take part will receive a short questionnaire by post at 6 - 8 weeks after giving birth. The questionnaires will ask women about aspects of their health and what they thought about their care.

When you go home after giving a birth, the midwife will hand you an information leaflet about the study. If you have had your baby at home, the community midwife will provide this information to you.

Researchers from King's College London:
Marie Furuta (PhD student) (marie.furuta@kcl.ac.uk)
Professor Debra Bick, Professor of Evidence Based Midwifery Practice
Professor Jane Sandall, Professor of Women's Health

Appendix 15. Poster for midwives

Study site logo

NHS Foundation Trust

KING'S College LONDON

Women's health after having a baby

A study is currently being conducted at this hospital. We would like to ask for midwives' support.

Study aims & background

The study aims to assess the impact of an adverse event on maternal psycho-social & physical morbidity at 6-8 weeks after childbirth

Adverse obstetric events are rising due to:

- Increased interventions during birth
- More complex medical needs of pregnant women

The most common adverse event is postpartum haemorrhage

For the majority of UK women, adverse events will not result in loss of life, *but* ***consequences for maternal psycho-social & physical morbidity are unknown.***

Methods

Study sample: Women who give birth under the care of staff in St. Thomas' hospital (exclusion criteria: private patients, those under 16 years old, or unable to read English)

Recruitment period: Over 6 months in 2010

Data collection:

- Health outcomes after birth: a short self-administered questionnaire will be sent to women at 6-8 weeks. This will include validated measures to assess maternal psycho social and physical health and well-being
- Data on adverse obstetric events will be obtained from electronic maternity records

Potential contribution of study

The improvement of maternal health in the UK through providing information for NHS policy and implication of practice on:

- Incidence and prevalence of postnatal morbidity following adverse obstetric events
- Women who are most at risk
- How to better plan & manage risk to minimise impact of adverse obstetric events

Thank you very much for offering women the study package prior to their discharge!

Researchers from Kind's College London
Marie Furuta(PhD student)
Professor Debra Bick, Professor of Evidence Based Midwifery Practice
Professor Jane Sandall, Professor of Women's Health

For more information contact
marie.furuta@kcl.ac.uk
Tel: 0207 848 3625
Mobile: 078 6397 8520

Appendix 16. Letter for midwives

Study site logo

NHS Foundation Trust

Dear Colleague

I am a midwife and postgraduate research student at the Florence Nightingale School of Nursing & Midwifery King's College London and I am writing to ask for your support for a research project I am undertaking as part of my PhD program. My study supervisors are Professor Debra Bick and Professor Jane Sandall.

The aim of my research is to explore the impact of experiencing an adverse obstetric event on women's psycho-social and physical health and well-being during the postnatal period. This is an important topic since, as you may be aware, the number of adverse obstetric events has been increasing (which can include postpartum haemorrhage and preeclampsia/eclampsia), largely as a result of the changing demographic characteristics of women who become pregnant and increased interventions during labour and birth. For some women, even those who may have had a normal birth, it is also apparent that birth can be a traumatic experience. This experience may trigger post-traumatic stress disorder as well as other psycho-social and physical problems. Women at risk need to be identified and appropriately treated as early as possible before adverse events cause long-term harm for the women themselves, their children, families, and society as a whole.

We have yet to fully understand the consequences of experiencing an adverse obstetric event during birth on women's postnatal health outcomes, and little known about which aspects of adverse events are more likely to be associated with poor postnatal outcomes. We also do not know if women who have had an adverse event have a higher risk of postnatal health problems. This study therefore hopes to address some of the gaps in this area of knowledge.

I intend to collate information on women's experiences of their postnatal health though a postal questionnaire. All women who give birth at St. Thomas' Hospital (except for those aged 16 years old or younger) from June to December 2010 will be invited to participate in this study. They will be asked to answer a questionnaire, at 6 weeks after their baby's birth. Access to some information from medical record will

also be needed in order to understand whether participants experienced an adverse obstetric event. I have discussed my work with Mrs Lynne Packanowski and senior midwifery managers at the unit, who have offered their support.

I would be extremely grateful for your help with informing women about my study. More specifically, I would like you to offer all women who fulfil study inclusion criteria (information on which are enclosed for your information) a study information leaflet and a study opt-out letter prior to their discharge. I have also enclosed an information sheet and an opt-out letter for your information.

The study will be completed by the end of 2011, when I would be very happy to provide you with a summary report of the results.

Many thanks for considering my request

Yours sincerely,

Marie Furuta

Marie Furuta
Florence Nightingale School of Nursing & Midwifery
King's College London
TEL: 0207 848 3625
E-MAIL: marie.furuta@kcl.ac.uk

Appendix 17. A report for data entry and error correction

1. Strategy to reduce data entry error - Postal questionnaire

To minimise data entry errors from postal questionnaires, this study contracted an experienced company, Market Research Group (MRG), to enter data. Manual data entry was undertaken by trained staff into an individually designed format using Snap, a software which allowed the questionnaire to be fully coded at the data entry stage, therefore reducing possible coding errors. The forced response was also set up in the data entry format prior to data entry to ensure no data would be omitted. The data quality was checked at two levels by MRG: once at the data entry level by a quality control supervisor who checked for format, inconsistencies and extreme outliers, and then re-entered 10% of cases to compare the levels of accuracy; and another by the data manager for overall quality. The dataset was given to the researcher in the form of an SPSS file. *(We have not received the report of quality checking that showed the results of re-entering 10% of cases by a quality control supervisor.)*

The accuracy of data entry was double-checked by the researcher after consultation with a senior data manager and academic supervisors at King's College London. First, the occurrences of duplicated, missing and misread study IDs were carefully checked using an SPSS frequency table and manually checking by comparing study IDs entered in the SPSS files and those that existed on the original questionnaires. Other data (e.g., date of completion of the questionnaire, SF-12, postnatal care) were checked when necessary for the identification of the correct study ID. Although the process was tedious, it was crucial for this study because there were a number of separate tables (i.e., dataset from clinical record and dataset from the STOP study) that needed to be marginalised to create the final dataset for analysis; the study ID was used to do so, together with the clinical patient ID. The next stage of ensuring data quality was checking 10% of questionnaires (i.e. 180) that were randomly selected and checking each entry in the SPSS file. Two persons (the researcher and her colleague) were involved in this process; one read the results of original questionnaire and another checked the data entered in the SPSS file. Finally, frequencies of each variable, table and graph were reviewed in order to highlight inconsistency and outliers. Corrections were made if necessary.

2. Findings of data quality check

2.1 Study ID

There were 27 errors in study ID which were corrected as shown in table A16-1.

Table A16-1 Error correction in study ID

Missing study ID	***Reasons for missing***	***Correction***	
429	Misreading		
478	Misreading	(as shown below)	
1219	Misreading	(as shown below)	
1877	Misreading	(as shown below)	
1991	Misreading	(as shown below)	
2037	Misreading	(as shown below)	
2234	Misreading	(as shown below)	
2239	Misreading	(as shown below)	
2946	Misreading	(as shown below)	
3239	Misreading	(as shown below)	
3294	Misreading	(as shown below)	
3296	data was not entered from the questionnaire	data entry is needed	
3554	Misreading	(as shown below)	
Duplicated study ID	***Reasons for duplication***	***Correction***	***Other errors in corrected ID***
498	Misreading	One of 498→478	
1218	Misreading	One of 1218→1219	
1827	Misreading	One of 1827→1877	q21 (16/10/2010→16/11/2010)
1911	Misreading	One of 1911→1991	
2334	Misreading	One of 2334→2234	q6a (missing→5) q6b (missing→5)
3229	Misreading	One of 3229→3239	
3299	Misreading	One of 3299→3294	q10c (missing)
516	Entered twice	Removed one	
3378	Entered twice	Removed one	
ID should not exist	***Reasons for existence***	***Correction***	***Other errors in corrected ID***
1946	Misreading	1946→2946	
2038	Misreading	2038→2037	q3a (missing→2) q6a (2→4) q6b (4→3) q7a (5→7) q7b (7→6) q7c (6→1) q7e (1→7) q7f (7→4) q7g (4→1) q7h (1→7) q7i (7→1) q7j (1→7) q10c (missing) q10d (missing)
2339	Misreading	2339→2239	q10c (missing)
3559	Misreading	3559→3554	
4299	Misreading	4299→429	

2.2 Checking 10% of questionnaires

A total of 180 questionnaires were selected by choosing every tenth study ID number. Of which, 89 questionnaires (49.4%) had at least one error, and there were often multiple errors. Errors were caused by both data entry person and study participants. Of 180 questionnaires, 84 questionnaires had errors that were caused by the data entry person (46.6%), while 6 questionnaires had errors caused by the participants filling in the questionnaires such as using N/A or not ticking a box that had an obvious answer (3.3%). The errors caused by the participants were heighted in table 2 to clarify the cause of errors.

The level of accuracy varied between questions. For example, there were few errors in Labour Agentry Scales (Q7a-Q7j), while there were many (1 in 3) in postnatal care questions (Q10-Q10g). Errors in Impact Event Scales and Edinburgh Postnatal Depression Scales were also substantial, although this key data measures outcomes of interests in this study.

Table 16-2 Errors identified in 10% of total questionnaires

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
20							
48		q9 (1→2)					
75							
128	q6a (2→3) q6b (2→3)	q10a_2 (0→1) q10b_1 (0→1) q10b_3 (0→1) q10c (missing reason for GP visit) q10e (missing reason for community clinic visit)					
221							
327							
374					q16a (2→1) q16b (4→2) q16c (2→4) q16d (4→2)		
439		q10 (1→2) q10a_1 (missing→1) q10a_2 (missing→1) q10b_1 (missing→1) q10c (missing reason for GP visit)					
467							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
496					q16b (3→1) q16c (1→3) q16d (3→1) q16f (4→3) q16g (3→4) q16h (4→3)		
506							
529							
563							
588	q5a (2→1)						
603							
620							
632							19_1 (1→0)
653						q17b (0→1) q17d (1→0) q17f (0→1)	
678			q7c (3 →4) q7d (5→3) q7f (3→4) q7g (4→3) q7h (3→6)				
705		q10a_1 (0→1) q10b_5 (0→1)					
723							
744							
758							
761		q10a_2 (0→1) q10b_3 (0→1) q10e (missing reason for community clinic visit)					
775		q10c (missing reason for GP visit) q10d (missing reason for child. centre visit)					
804							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
826		q10a_2 (0→1) q10b_5 (0→1) q10g (caught & colds)					
843							
861		q11 (1→2) q11b (missing reason for readmission → stomach infection and headache)		q14b (missing→n/a) q14e (missing→n/a) q14h (missing→n/a)			
876							
892							
912							
930				q14f (missing→1) q14h (1→3) q14i (3→4)			
955		q10b_2 (0→1) q10d (missing reason for Children's centre visit→ vomiting)					q18 (2→1)
973							
989							q19_1 (missing→0) q19_2 (missing→0) q19_3 (missing→1) q19_4 (missing→0) q21 (14/09/2010→18/09/2010)
1004		q10d (missing reason for Children's centre visit)			q16c (1→3) q16d (3→1) q16e (1→4)	q17o	
1024							
1047							
1072		q10c (missing reason for GP visit→ remove of stiches post c/s)					
1096							
1117							
1140				q14a (1→4)			
1164				q14j (1→3)			

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
1181		q10g (missing reason for private paediatrician → breast-feeding) 11a/11b→ 12a/12b					
1199		q9 (1→2)					
1218	q4a (2→1) q4b (2→1)						q21 (02/10/2010→04/10/20)
1234							
1251						q17b (1→missing) q17j (missing→ 3)	
1276							
1303		q10a_1 (missing→1) q10a_2 (missing→1) q10b_1 (missing→1) q10c (missing reason for GP visit→ to check my haemoglobin level & baby cord)					
1321							
1349							
1367		q10c (missing reason for GP visit→ abdominal pain)					
1393							
1411		q10 (1→2) q10a_1 (missing→1) q10a_2 (missing→1) q11 (1→2) q13 (1→2)					
1424							
1437		q10c (missing reason for GP visit→ breast soreness)					
1459		q10c (missing reason for GP visit→ oral thrush)					

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
1472				q14i (missing→n/a) q14j (missing→n/a)			
1485							
1500							
1517							
1538							
1552		q10b_5 (missing→1)					
1570							
1590							
1607							q19_1 (missing→1) q19_2 (missing→0) q19_3 (missing→0) q19_4 (missing→0)
1622							
1641		q10c (missing reason for GP visit) q10f (missing reason for PN clinic→ hip scan)					
1658							
1674		q10c (missing reason for GP visit) q10d (missing reason for child. centre)					
1696							
1715							
1732							
1748		q10c (missing reason for GP visit→ need iron tablet)			q16h (1→4)		
1772				q14i (missing→3)	q16g (3→4) q16j (3→4)		
1787							
1811							q19_4 (0→1)
1832		q10c (missing reason for GP visit→ baby too much crying)					
1856				q14j (missing→3)			
1870							
1888				q14c (missing→1) q14d (4→1) q14e (1→4)			
1910							q18 (1→4)
1926							
1941							
1956							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
1976		q10c (missing reason for GP visit→ high BP) q10d (missing reason for child. centre) q10e (missing→ weight baby)					
1981							
1994							
2009							
2033							
2052		q10g (missing→ A&E, chock the milk, breathless)				q17j (1→3) q17m (3→2)	
2067		q10c (missing reason for GP visit)					
2095							
2115		q10b_1 (1→0)					
2131							
2149		q11 (1→2) q11b (missing reason for readmission → severe & sudden onset headache					
2165							
2186							
2201		q10a_1 (1→0)					
2221							
2244							
2264		q9 (2→1) q10d (missing→ hearing test)	q7f (missing →2) q7g (2→missing)				
2277		q10b_3 (0→1)					
2296		q10c (missing → colic) q10e (missing→ weight baby)					
2318							
2334							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
2348		q10b_5 (0→1) q10g (missing→ inpatient NICU baby jaundiced& unwell					
2369							
2392						q17h (missing→ 2)	
2404							
2429							
2450					q16i (missing→ 3)		
2471		q11 (1→2) q11a (missing→6 weeks – 42days) q11b (missing →bladder injury at birth, re-operation on bladder)					
2495		q10c (missing) q10f (missing)					
2511			q7d (missing →3)			q17e (1→5)	q21 (25/12/2010→23/12/2010)
2530							q21 (02/10/2010→02/01/2011)
2558							
2574		q10b_5 (0→1) q10c (missing→ baby conjunctivitis & mastitis) q10d (missing→ breast feeding) q10g (missing→ breast feeding, mother stress)					
2589		q8b (2→3)				q17o (1→2)	
2608							
2624							
2649							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
2663	q1 (3→1) q2b (2→3) q5 (1→2) q6a (2→1) q6b (6→2) q6c (5→6) q6d (4→5)		q7b (5→4) q7c (3→5) q7d (4→3)				q19_1 (0→1) q19_4 (1→0) q20a (missing) q20b (missing)
2684	q6a (2→6) q6b (3→2) q6c (4→3) q6d (6→4)	q10c (missing) q10d (missing→ immunisation)					q21 (06/02/2011→06/01/2011)
2709		q13 (missing→2) q13a (missing→2)					
2725							
2749		q10f (incomplete → break out the staples) q11a (missing→ 6-7) q11b (missing→ break out the staples)					
2772							
2786		q10f (missing)					
2808							
2830							
2861			q7g (missing →6)		q16d (4→1)	q17a (3→2)	
2874		q10c (missing→ check-up)					
2890							
2912							
2933							q20b (missing→ free text dissatisfaction)
2952							
2977							
2995		q10c (missing→ rush)					
3014							
3031							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
3051							
3067		q10c (missing→ vomiting)					
3088						q17o (missing→ 1)	
3106							
3134							
3155							
3180		q10c (missing) q10e (missing) q10f (missing)					
3199							
3222							
3241		q10c (missing) q10f (misreading)					
3258							
3280							
3301							
3321							
3347							
3378							
3380		q10b_5 (0→1)					
3398		q10c (missing)					
3419						q17o (missing→ 1)	
3447					q16e (2→4)		
3468		q10c (missing)					
3485		q10c (missing)				q17j (1→3)	
3505	q5 (2→1) q6b (1→2)	q10c (missing) q10e (missing)					
3519							
3541		q10a_1 (1→0) q10a_2 (0→1)					
0056 B		q9 (1→2)					
113 W		q9 (1→2)					
148 N							
168 G							

Study ID	SF12	Postnatal care	LAS	Social support	EPDS	IES	Others
185 G		q8a (7→6) q10a_1 (0→1) q10b_5 (0→1) q10g (missing→ jaundice)					
207 R							
229 R		q10b_5 (0→1)					
283 B							
305 J		q10b_3 (0→1)	q7b (1→2) q7c (2→3)		q16e (missing→ 4) q16f (missing→ 3) q16g (missing→ 4) q16i (missing→ 3)		
338 W							
360 P							q20b (free text dissatisfaction)
448 J		q10c (missing) q10d (missing)					
477 P							
92 B		q10b_2 (0→1) q10d (missing→ breastfeeding help)				q17n (1→2) q17o (1→2)	

2.3 Data cleaning - Checking for consistency and outliers

A new variable was created in SPSS to look at the time for completion of postnatal questionnaires (time difference between date of birth and date for completion of questionnaire). 5.6% of questionnaire had impossible figures (the time for completion was before the date of delivery (3.9%) or before sending questionnaire (1.3%), ranging from minus 513 weeks to 4 weeks postnatal. 0.3% of questionnaire was competed after 41 weeks which was also impossible figure). In addition to 5.6% of questionnaire, another 10% of questionnaires had figures which need to be re-checked since these questionnaires were completed at 5 weeks, while questionnaires were sent to women at 6 weeks postnatal. Data for data of birth was within normal range (from 7th June to 21 December 2010).

Table A16-3 Time for completion of postnatal questionnaire (weeks)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-513	1	.1	.1	.1
	-463	1	.1	.1	.1
	-47	1	.1	.1	.2
	-46	1	.1	.1	.3
	-45	2	.1	.1	.4
	-43	7	.4	.5	.9
	-42	12	.7	.8	1.8
	-41	10	.5	.7	2.5
	-40	2	.1	.1	2.6
	-39	2	.1	.1	2.7
	-38	1	.1	.1	2.8
	-36	5	.3	.4	3.2
	-35	2	.1	.1	3.3
	-34	1	.1	.1	3.4
	-28	1	.1	.1	3.5
	-27	1	.1	.1	3.5
	-22	1	.1	.1	3.6
	-10	1	.1	.1	3.7
	-3	2	.1	.1	3.8
	-2	2	.1	.1	3.9
	1	2	.1	.1	4.1
	2	6	.3	.4	4.5
	3	4	.2	.3	4.8
	4	6	.3	.4	5.2
	5	140	7.6	9.9	15.1
	6	424	23.1	29.9	45.0
	7	297	16.2	20.9	65.9
	8	141	7.7	9.9	75.8
	9	142	7.7	10.0	85.8
	10	91	5.0	6.4	92.2
	11	28	1.5	2.0	94.2
	12	32	1.7	2.3	96.5
	13	10	.5	.7	97.2
	14	7	.4	.5	97.7

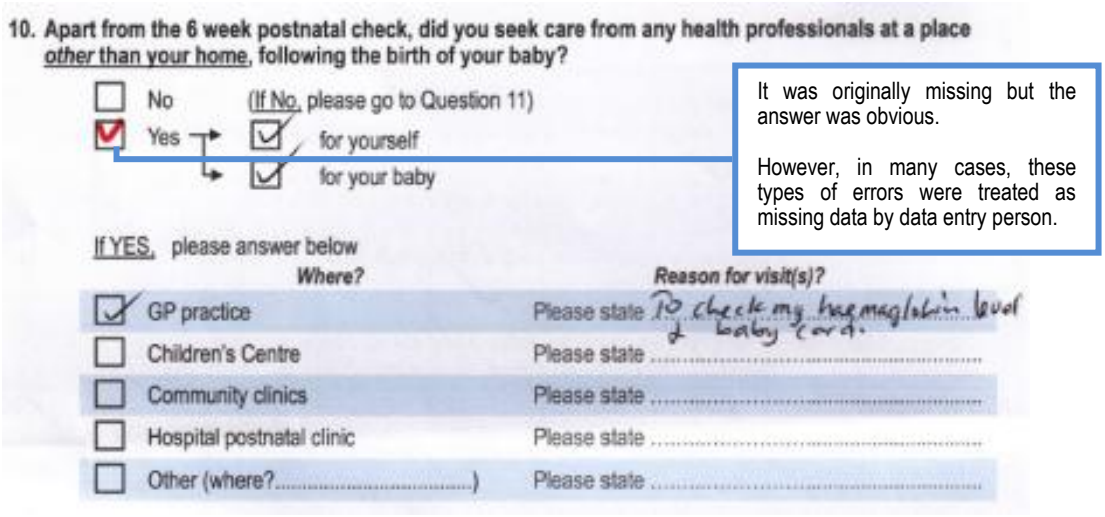
	15	7	.4	.5	98.2
	16	4	.2	.3	98.4
	17	3	.2	.2	98.7
	18	6	.3	.4	99.1
	20	3	.2	.2	99.3
	21	1	.1	.1	99.4
	22	1	.1	.1	99.4
	27	1	.1	.1	99.5
	30	1	.1	.1	99.6
	41	1	.1	.1	99.6
	49	1	.1	.1	99.7
	52	2	.1	.1	99.9
	61	1	.1	.1	99.9
	62	1	.1	.1	100.0
	Total	1419	77.3	100.0	
Missing	System	417	22.7		
Total		1836	100.0		

From the frequencies variable, tables and graphs, other major issues with outliers and inconsistency were not observed for variables which were coded. However, it might be possible that because of the way of programming the database, these errors could not be identified. For example, to minimise possible coding errors, the format were designed to be fully coded at the data entry stage, which might not have allowed outliers to be entered. Moreover, if the database was programmed to automatically skip certain questions depending on the answer to prior questions that came before (skip logic) and if participants missed the first question, it would not have any option to entre data for the subsequent questions.

Example in which errors were not identified by data cleaning

There were questions that women did not answer, but from the context, the answer was obvious. For example, in a question, “Did you seek care from any health professionals at a place other than your home following the birth of your baby?” women did not tick either box “yes” or “no.” However, they answered the subsequent questions, which were only applicable if the answer was “yes” (i.e., Did you seek care “for yourself,” “for your baby,” “where and reason for visits?”). In such a case, the missing answer in the first question should have been treated as “yes.” However, in many cases, the answer in the question was treated as missing, and subsequent questions were skipped, such that women’s answers were completely ignored and omitted, resulting in the loss of information provided by participants (Figure 1). If this is the case, data cleaning would not be able to identify these errors because the answers were consistent.

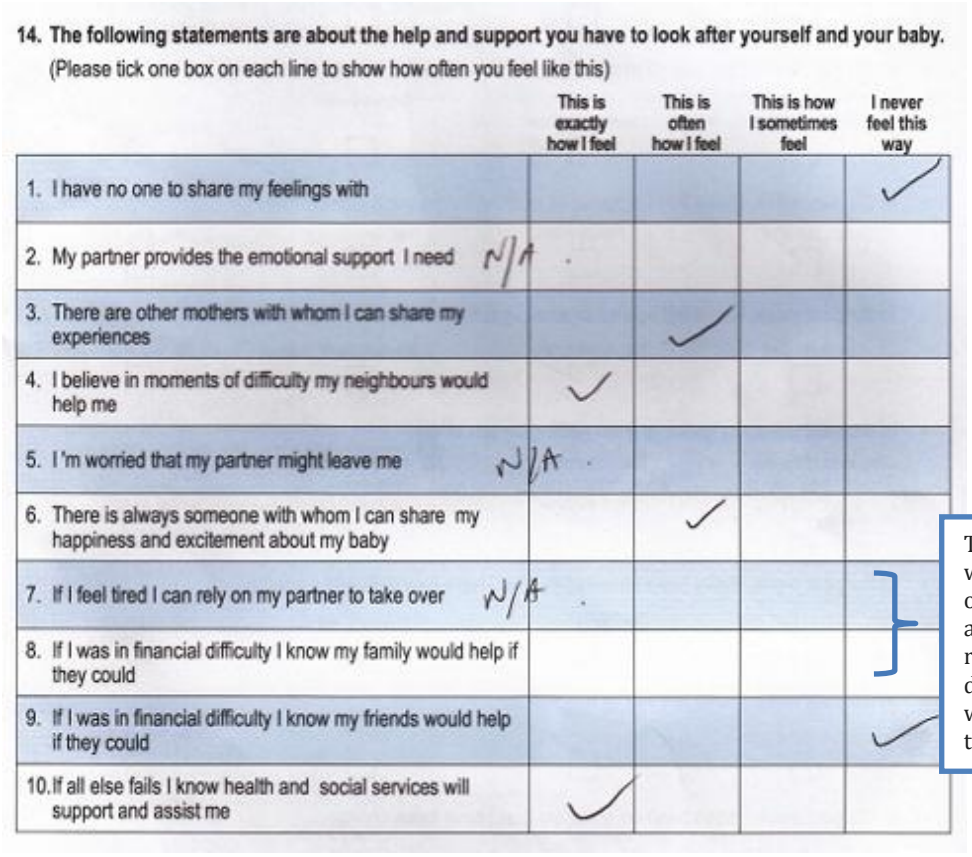
Figure A16-1 Example - data cleaning cannot identify errors if data were not entered accurately



3. Other issues: missing or non-applicable

There were questions that were not applicable to some women. For example, in questions of "social support scale," women were asked to rate perceived support from their partner on a 4-point Likert scale. Some single mothers did not rate, because the question was not applicable to them. Some women therefore put the word "N/A" instead of just skipping the questions (Figure 2). During data entry, these answers (N/A) should have been distinguished from missing values caused by no answer because "N/A" and "no response" would be treated differently in analysis dealing with missing data. From the current dataset, it is not possible to distinguish between N/A and non-response, because these were left as blank in SPSS.

Figure A16-2 Example – N/A or non-response



14. The following statements are about the help and support you have to look after yourself and your baby.
(Please tick one box on each line to show how often you feel like this)

	This is exactly how I feel	This is often how I feel	This is how I sometimes feel	I never feel this way
1. I have no one to share my feelings with				✓
2. My partner provides the emotional support I need N/A				
3. There are other mothers with whom I can share my experiences		✓		
4. I believe in moments of difficulty my neighbours would help me	✓			
5. I 'm worried that my partner might leave me N/A				
6. There is always someone with whom I can share my happiness and excitement about my baby		✓		
7. If I feel tired I can rely on my partner to take over N/A				
8. If I was in financial difficulty I know my family would help if they could				
9. If I was in financial difficulty I know my friends would help if they could				✓
10. If all else fails I know health and social services will support and assist me	✓			

These answers were missing but one was N/A, another was non-response. During data entry, these were treated in the same way.

4. Possible ways of improving data quality

Errors occurred in almost half of questionnaires checked. The numbers of errors were also found during data cleaning and study ID check. In order to improve the quality of the dataset, I would like to ask the MRG, Bournemouth University to re-check whole dataset and re-enter some variables.

More specifically, I would like the MRG to do following:

1. Re-enter Q10 – Q12b in Section 3 (postnatal care) using code book; the researcher will provide the MRG. Errors were more than 10% for these questions (particularly from Q10b-1 to 10b-5), which meets our agreement made prior to our contract.
2. Re-enter Q21 (errors appeared to be more than 10%)
3. Double-check the quality of data entry, in particular with Q16 (EPDS) and Q17 (IES). Since these are key questions in the study, even small errors would affect the study results.
4. Create code "N/A" to distinguish non-response and apply it where applicable.
5. Provide the report of level of accuracy after 10% re-entering data of whole questionnaires after completing actions 1, 2 and 3 above (selecting different study ID checked here).
6. Keep all records of errors and correction and provide the report

Alternatively, I would like to ask the MRG to re-enter whole data.

Appendix 18. A letter from MRG

Data entry and corrections

Introduction

The Market Research Group (mrg) is an established market and social research company based at Bournemouth University.

The group is committed to ensuring that projects are managed to achieve the recognised quality standards for market and social research.

These standards are described in the code of practice for the Market Research Society and in the service requirements of the international standard for social and market research ISO 20252 and are actively supported by the international research regulatory organisation ESOMAR.

Data entry

The Market Research Group (mrg) took receipt of 1841 completed surveys (no deadwood) and re-entered each case, as requested, with the upmost levels of care and attention.

The manual data entry of the project was undertaken by two, fully-trained members of staff, both with two and one year's experience in their roles respectively.

Data was entered using SNAP, which allowed the survey to be fully coded at this stage.

Changes to the data entry file

As before, SNAP files were set up with forced responses to avoid possible coding errors and, as previously requested, the following changes were made to the data entry SNAP file:

- a 'NA' option was added to relevant questions
- missing data was left blank
- questions 10-12b have been entered using the codes provided
- the variable in question 18 was split to allow for multiple responses
- multiple responses were coded by using the 'larger number' (as indicated by Marie Furuta - MF).

Issues with data

Some respondents did not follow the questionnaire's routing properly and in these instances, the data entry staff used common sense to apply the correct routing. These changes were later checked and verified by quality control supervisors.

Any issues found with coding question 10 correctly were sent to MF for further clarification and the requested changes, when received, were expedited immediately to the data set.

With questions 11b and 12b, there was a certain ambiguity to the respondent's answers, especially in regards to responses to 12b. Answers such as "dehydration", "breathing difficulties" and "choking incident" could be attributed to a range of different reasons and therefore their coding could be seen as rather problematic. Unless the reason was clearly specified, these more ambiguous answered were coded as 'baby other' (30).

Multiple responses were coded by using the 'larger number', as indicated in correspondence with MF.

Checking

Due to previous issues, the accuracy of the data entry was checked in three stages: a brief check by the data entry staff to check for any obvious inconsistencies, a check of 70% of cases by two quality control supervisors analysing format, further inconsistencies and extreme outliers and a final 20% check. At each of these stages, corrections were made if necessary.

Due to the robustness of our quality checking procedures and the number of cases checked, we have not re-entered 10% of cases as each variable and open-ended has been checked for accuracy.

We have also paid special attention to the numerical questions that have previously been indicated as problematic, including Q16, Q17 and Q21.

At this stage, all 'NA' responses were coded numerically as '999', as requested.

Conclusion

With further care and attention to manual data entry and the detailed nature of our checking procedures, we are now confident of the integrity the data set.

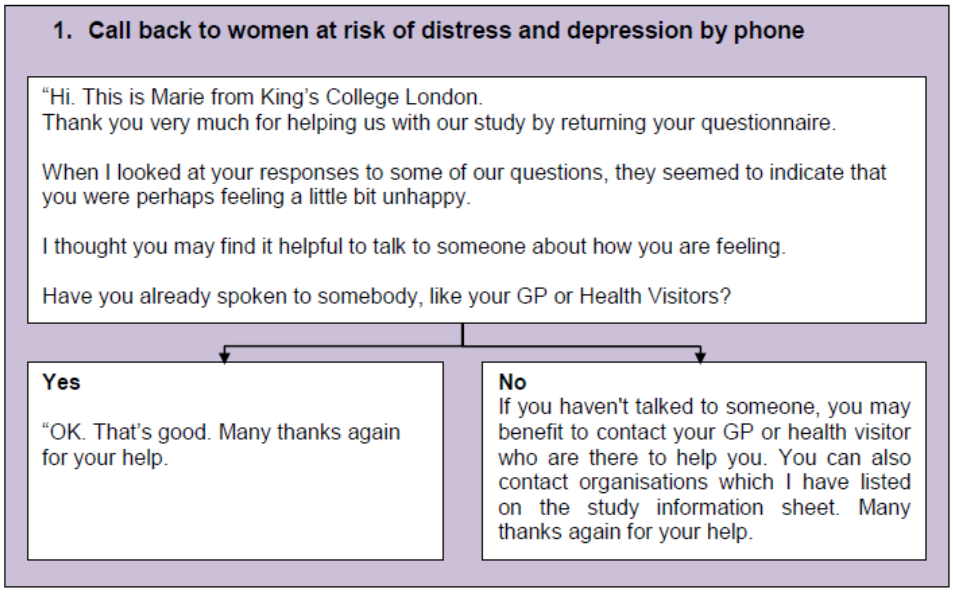
Appendix 19. Missing values

Variables	Data cleaning and quality check	Note	Available N (9%)	Missing N (%) and reasons
Age	Checked all missing cases	n/a	N=1824 (100%)	N=0 (0%)
Parity	Checked all missing cases,	n/a	N=1824 (100%)	N=0 (0%)
Ethnicity	Checked all missing cases	n/a	N=1824 (100%)	N=0 (0%)
Living arrangements	Checked all missing cases	In cases of double tick, priority was put on 'partner' first, then 'parents/sisters/brothers' second, and finally 'others'. Women who ticked 'alone' did not tick other.	N=1802 (98.8%)	N=22 (1.2%) - question not answered by participants
Women's education	Checked all missing cases	In cases of double tick, the highest educational qualification was selected.	N=1791 (98.2%)	N=33 (1.8%) - question not answered by participants
IMD	Checked all missing cases	n/a	N=1805 (99%)	N=19 (1%) - postcode not recognised (miscoded or outside of England)
BMI	Checked all cases with BMI ≤15 and BMI≥39. Checked all missing cases	4 cases were treated as missing data due to unrealistically low BMI (3.9-8.3; weight 9.5-22kg; heights 157-163cm) and data were unsupportive from medical records. Although there were cases with extreme high values of BMI (51.0-60.6), these appeared to be true cases as the issue of obesity, a raised BMI or eating disorder were mentioned in clinical records.	N=1777 (97.4%)	N=47 (2.6%) - not recorded (n=43) - unrealistic (n=4)
Mental health history	Checked all missing cases	n/a	N=1797 (98.5%)	N=27 (1.5%) - not recorded
Place of delivery	Checked all missing cases	n/a	N=1824 (100%)	N=0 (0%)
Mode of delivery	Checked all missing cases and 'others'	n/a	N=1824 (100%)	N=0 (0%)
3rd/4th degree perineal tear	Checked consistency with mode of delivery. Checked all missing cases, where accessible.	n/a	N=1822 (99.3%)	N=13 (0.7%) - not recorded (n=3) - inaccessible/no consent (n=10)
Manual removal of placenta	Checked consistency with mode of delivery. Checked all missing cases, where accessible.	n/a	N=1820 (99.2%)	N=15 (0.8%) - inaccessible/no consent (n=10)
Obstetric haemorrhage	Cross-checked all cases of blood transfusion and all cases of estimated blood loss ≥ 1000ml recorded in electronic maternity records with the records in Blood Transfusion unit with the assistance of a Senior Biomedical Scientist. Checked all missing cases, where accessible.	Where there was discrepancy of the number of blood transfusion units women received between maternity records and transfusion records (n=2), transfusion records was used as it was more reliable data source. There were eight cases in which data on estimated blood loss were missing, although none of these received any blood transfusion. These were treated as missing data.	N=1816 (99.6%)	N=8 (0.4%) - estimated blood loss not recorded (n=8)

Variables	Data cleaning and quality check	Note	Available N (9%)	Missing N (%) and reasons
Pre-eclampsia (PET)/ Eclampsia/ HELLP	Checked all cases of diagnosed PET/eclampsia, its clinical features and management process. Cross-checked the number of cases of eclampsia recorded in electronic maternity records with a hospital monthly report in the study period. Cross-checked the case of HELLP syndrome with the HDU admission book with assistance of a clinical midwife and a HDU staff. Checked all missing cases, where accessible.	Seven severe PET (without eclampsia) were identified from electronic clinical record, of which three cases were diagnosed severe PET. Additional three severe PET were confirmed with the definition of severe PET recommended by National Collaborating Centre for Women's and Children's Health (2011). There were four cases of diagnosed eclampsia, one of whom had HELLP syndrome. The case was confirmed with a clinical midwife and a HDU staff who reviewed the HDU admission book.	N=1825 (99.5%)	N=10 (0.5%) - inaccessible/no consent (n=10)
HDU admission	Checked all cases of HDU admission and its indication. Received opinions from a clinical midwife where the indications of the HDU admission were unclear. Checked all missing cases, where accessible	One case of HDU admission was treated as 'non HDU admission' because the reason for HDU admission was 'no other bed available'.	N=1824 (99.5%)	N=10 (0.5%) - inaccessible/no consent (n=10)
Gestational age at delivery	Checked all missing cases, where accessible. Checked all cases with gestational age 33 wks and beyond (no cases with less than 24 wks)	There were five cases of gestational age of 43 weeks and beyond. These were considered to be true cases as the issues of post term were mentioned in clinical records.	N=1824 (99.5%)	N=10 (0.5%) - inaccessible/no consent (n=10)
Birth weight	Checked all missing cases, where accessible. Checked all cases with birth weight less than 1000g and greater than 5000g Consistency checked with gestational age at delivery, NICU admission and other issues	All cases with birth weight less than 1000g and greater than 5000g appeared to be true cases. A baby with 5000g was born to a mother with gestational diabetes which was poorly controlled. All baby with less than 1000g were preterm and entered to NICU	N=1818	N=16 (0.9%) - inaccessible/no consent (n=10) - not recorded (n=6)
Apgar 1 minute	Checked all missing cases, where accessible. Checked all cases with Apgar ≤3 Consistency checked with NICU admission and resuscitation	There were two cases with Apgar at 1 minutes was 0. Breathing established after 5 minutes in NICU.	N=1816 (99%)	N=18 (1%) - inaccessible/no consent (n=10) - not recorded (n=8)
Apgar 5 minutes	Checked all missing cases, where accessible. Checked all cases with Apgar ≤3 Consistency checked with NICU admission and resuscitation	There were two cases with Apgar at 5 minutes was 0. Breathing established after 5 minutes in NICU.	N=1818 (99.1%)	N=16 (0.1%) - inaccessible/no consent (n=10) - not recorded (n=6)

Appendix 20. Protocol for contacting women at risk of depression and distress

Protocol for contacting women at risk of depression and distress



Appendix 21. Sample representativeness – study participants vs. national cohort of women

Sample representativeness – study participants vs. women in England/ UK

In this section, the demographic and birth characteristics of the study sample and their level of severe maternal morbidity were compared with those of women in England and/or the UK, where data are available, to assess whether the study sample were representative of women in England or the UK.

Age

The Office for National Statistics (ONS) showed that the mean age of women giving birth in England and Wales in 2010 was 29.5 years, indicating that the study sample were older than the national average (mean age = 32.3 years) (Table A20-1).

Table A20 - 1 Maternal age at delivery

	Respondents	Study sample (All)	England†
Mean (years)	32.3	31.3	29.5

† Source: ONS (2011c) Live births in England and Wales by characteristics of birth 2010.

Index of Multiple Deprivation (IMD)

According to an Index of Multiple Deprivation (IMD) score based on the postcode, which measured the relative disadvantages of areas in England, 29% of study participants lived in the most deprived areas and another 46% in the second-most deprived areas. This figure indicates that study participants lived in relatively disadvantaged areas in England. However, the latest index of multiple deprivation (Southwark Analytical Hub, 2008) in the region where this study was conducted showed that the catchment areas of the study hospital did not rank well on the

overall IMD in England, and over half (58%) of the catchment areas were found in the 20% most deprived geographical areas in England. Moreover, the comparison between study participants and non-participants showed that women living in less-deprived areas in the region were more likely to participate in this study at a statistically significant rate. Therefore, study participants lived in less-deprived areas in one of the most deprived regions in England.

Table A20 - 2 IMD

	Respondents		Study sample (All)	
	%	N	%	N
Least	2.6%	(47)	1.9%	(66)
Fourth	6.9%	(125)	5.5%	(192)
Third	16.1%	(291)	12.5%	(432)
Second	45.6%	(822)	46.4%	(1607)
Most	28.8%	(519)	33.7%	(1166)
Total	**100%**		**100%**	

Percentages are derived from the total excluding missing data

Ethnicity

Data on the ethnicity of women giving birth in England were not collated and therefore not available. However, the percentage of live births in England and Wales to mothers born outside the UK was 25.1% in 2010, with the highest percentage in London (56.3%) (ONS 2011, Births in England and Wales by parents' country of birth, 2010). Although these data are not a proxy for ethnicity, since mothers born in the UK includes those born to parents who were earlier migrants (second and third generation), it indicates a wide range of different ethnic groups and cultures access maternity care in inner cities in England. Within the study population, there was a statistically significant difference in ethnicity between respondents and non-respondents, with responders more likely to be white and less likely to be black women.

Table A20 - 3 Ethnicity

	Respondents		Study sample (All)	
	%, mean	N	%, mean	N
White	60.4%		51.2%	
Black	23.7%		31.8%	
Asian	8.7%		8.8%	
Mixed/multiple	2.5%		2.5%	
Other	4.7%		5.7%	
Total	**100%**		**100%**	

Percentages are derived from the total, excluding unknown figures.

Education qualification

A total of 68.5% of participants had a degree or equivalent (or above) education qualification, higher than the national average. According to a recent labour force survey (2005), the percentage of the UK female population (of reproductive age) with higher qualification education ranged from 1.3% for those aged under 20 to 46.1% for those aged 25–29 (table 9.4). Compared to the national data, study participants were more educated, particularly for women aged 30–34 and above (69.6% to 81.1%).

Table A20 - 4 Education qualification

	Respondents		Study sample (All)		UK†	
	%	N	%	N	%	N
Highest education qualification						
None	4.8%	(86)	—	—	—	—
GCSE	11.6%	(207)	—	—	—	—
A-level	15.1%	(271)	—	—	—	—
Degree/equivalent	68.5%	(1,227)	—	—	—	—
Higher education qualification by age						
16–19	0%	(0)	—	—	1.3%	—
20–24	20.9%	(29)	—	—	26.8%	—
25–29	51.7%	(164)	—	—	46.1%	—
30–34	81.1%	(570)	—	—	39.4%	—
35–39	77.5%	(379)	—	—	32.8%	—
40–44	69.6%	(80)	—	—	33.1%	—
45–49	71.4%	(5)	—	—	30.6%	—

† Source: ONS (2005) Office for National Statistic Labour Force Survey.
Percentages are derived from the total, excluding unknown figures.

Summary

The current study sample may not be representative women in the UK as well as well as in the region in terms of demographic characteristics. This is because the study participants were older than the national cohort. In addition, there was a difference between the educational qualifications of the study participants and national cohort, with study participates having a higher level of educational attainment. There were also differences in socio-economic status measured by Index Multiple Deprivation (IMD) and ethnicity; the participants were in general more deprived and more diverse ethnically compared to other regions of England.

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Obstetric characteristics

Birth outcomes

The proportion of pre-term and term birth was similar to that of non-participants, as well as the rate in England. Women who participated in this study, however, had a higher rate of emergency caesarean birth (EmCS) and lower rate of spontaneous vaginal birth (SVD) compared to the national average, but the level of differences was smaller when compared to the non-participants. This reflects the characteristics of the study site, the tertiary hospital in an inner city of England.

Table A20 - 5 Birth outcomes

	Respondents		Study sample (All)		England†	
	%	N	%, mean		%, mean	*N*
Ges. age at birth						
<37	8.0%	(146)	8.3%	(290)	7.5%	(41,670)
>=37	92.0%	(1,678)	91.7%	(3,210)	92.5%	(510,864)
Mode of birth						
SVD	55.0%	(1,003)	57.3%	(1,988)	62.2%	(406,951)
Breech/instrumental	16.4%	(299)	14.0%	(485)	12.9%	(84,442)
ElCS	8.9%	(163)	9.4%	(326)	10.1%	(65,760)
EmCS	19.7%	(359)	19.3%	(668)	14.8%	(96,752)
Total	**100%**		**100%**		**100%**	

† Source: NHS Information Centre (2011) NHS Maternity Statistics 2010–2011, HES mode of delivery.
Percentages are derived from the total, excluding unknown figures.

Obstetric haemorrhage

The incidence of obstetric haemorrhage in the current study was similar to the UK overall incidence and probably reflects the true incidence of PPH in an inner city population in England. This assumption is supported firstly because the incidence of severe obstetric haemorrhage defined as an estimated blood loss of ≥ 2500ml or blood transfusion ≥ 5 units in the current study was 0.5%, similar to the rate of 0.52% in the latest Scottish Audit (2011) (as shown in Chapter 2). Secondly, no significant difference between respondents and non-respondents in the proportion of women who had severe obstetric haemorrhage was found in the current study, as described earlier (in Chapter 6). The incidence of obstetric haemorrhage, however has increased over the last decade in this region. Waterstone et al.,(2001) showed that the rate of severe obstetric haemorrhage (defined as an estimated blood loss of ≥ 1500ml or blood transfusion ≥ 4 units among women who had live births after 24 gestational age) was 0.67% in 1997–1998, while this study found a rate of 4% in 2010. Similar trends were observed in other UK studies, showing an increase in postpartum haemorrhage (NHS 2011, Lennox 2011b), as described in Chapter 2. The large difference in the incidence of severe obstetric haemorrhage between Waterstone et al.'s study and the current study is therefore likely due to the true increase in obstetric haemorrhage in the UK over the past decade, although careful records by clinical staff, as awareness of the importance of accurate recordkeeping grows, might also have played a part of the increase in the rate of postpartum haemorrhage.

Severe pre-eclampsia/eclampsia/HELLP syndrome

While the incidence of obstetric haemorrhage appeared to be generalizable to the UK population, a comparison of the level of severe pre-eclampsia/eclampsia/HELLP syndrome with the national average rates was more complex. There are no recent

data on severe pre-eclampsia with which to compare, but the proportion of women in this study who had severe pre-eclampsia, including eclampsia and HELLP syndrome, was 0.6%—slightly higher than the 0.46% observed in Waterstone et al.'s (2001) study. Four women out of 1,824 study participants had eclampsia, indicating the incidence of eclampsia to be 0.2%, ten times higher than that reported by Waterstone et al. (2001) (0.02%). The rate in this study was also higher than the latest Scottish Audit of severe maternal morbidity (Lennox, 2011b) and the UK nationwide survey (UKOSS) (Knight, 2007) (0.025% and 0.027%, respectively; see Chapter 2 for details). There are a number of possible reasons for this finding. First, the number of women who had eclampsia was small, so the incidence was less precise. Second, the current study was conducted in a large unit in the tertiary hospital where high-risk women are more likely to be referred from other maternity units. Third, and most importantly, there was a discrepancy between the hospital records and patients' clinical records at the study site. During the study period, there were only three cases of eclampsia among all women who gave birth at the hospital, according to the medical records, and none of these women participated in this study. However, after a careful check of individual participants' clinical records, among those who had pre-eclampsia, four cases of eclampsia were identified. Thus, the discrepancy may relate to the quality of record keeping.

In addition, one woman in the study sample with eclampsia also had HELLP syndrome. Because there are so few cases, it is not possible to compare the rate with other studies, but Waterstone et al. (2001) showed that the incidence of HELLP syndrome in South East Thames Region in 1997–1998 was very low (0.05%). Again, there is a lack of studies to estimate the incidence of HELLP syndrome to date. For this reason, the UKOSS (Knight et al., 2011) is currently conducting a

survey; results are unavailable as of yet but could provide new insight into the problem.

High Dependency Unit (HDU)/Intensive Care Unit (ICU) admission

Of the 1,824 participants, a total of 102 (5.6%) women were admitted to the high dependency unit (HDU) for close monitoring and intensive care, although none were transferred to the intensive care unit (ICU). Again, due to a lack of studies estimating HDU admission rates among the obstetric population in the UK, it is not possible to compare these findings with others. Regarding the ICU admission rate, only three women were admitted to the ICU during the study period, none of whom participated in the study. The rate of the ICU admission in the latest Scottish Audit (Lennox, 2011) was 0.15%, but because there are so few cases of ICU admission, it was not possible to assess representativeness in the current study with that of the Scottish Audit.

Summary

The current study sample appeared to be a relatively representative sample of the UK, in terms of the level of severe maternal morbidity particularly for women with major obstetric haemorrhage, which is the most common severe maternal morbidity, although the rates of other indicators of severe maternal morbidity were not comparable due to the small numbers of cases and/or lack of national data available for comparison.